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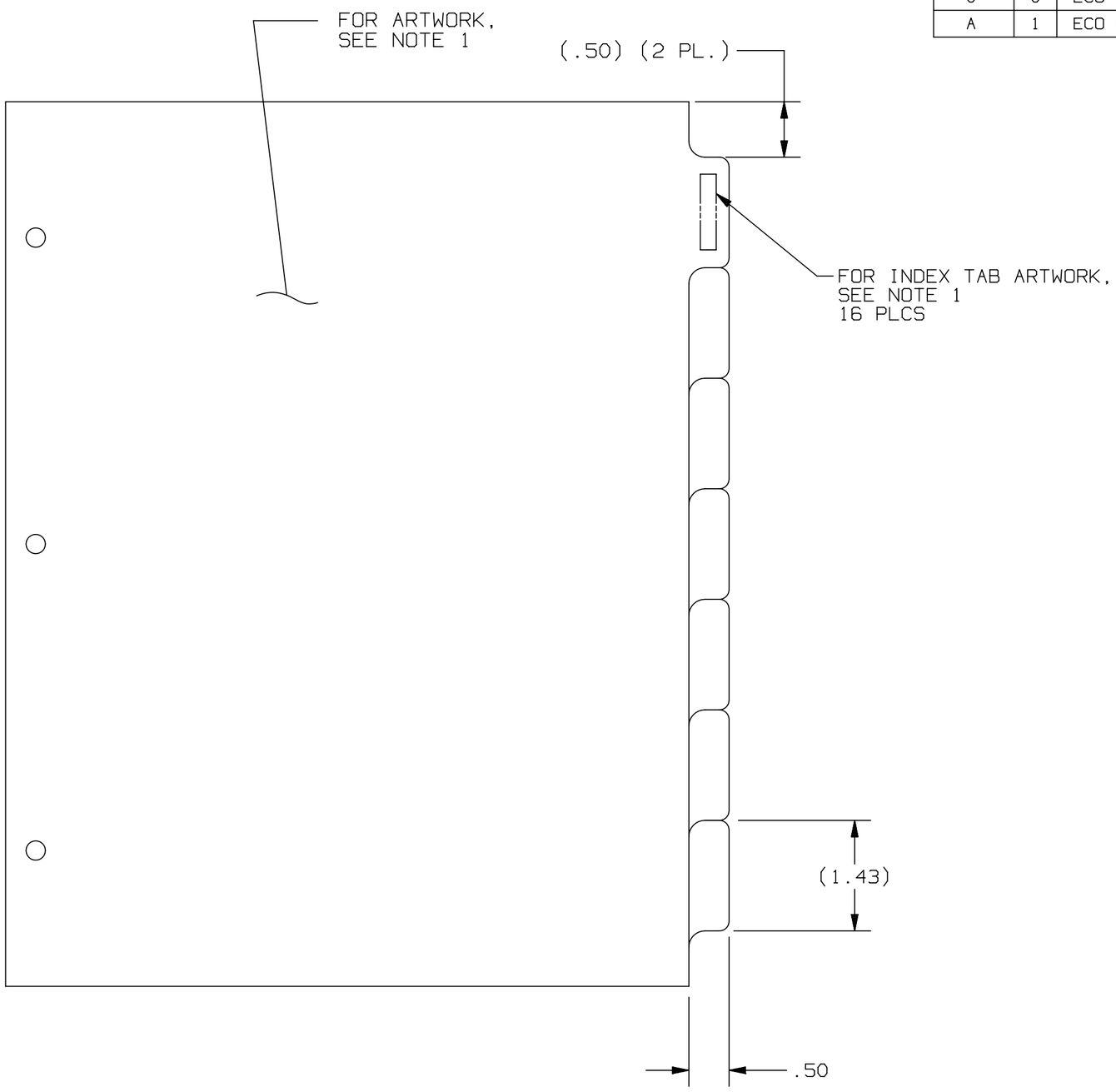

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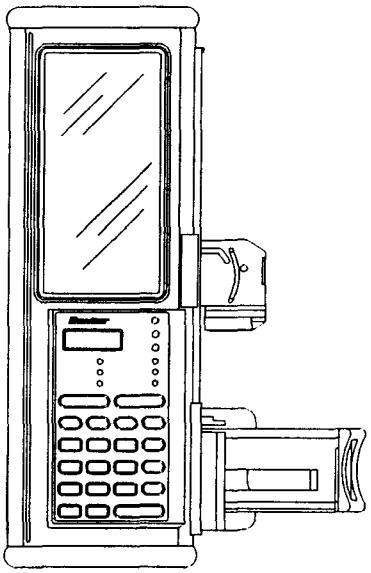

Auto Syringe® AS50 Infusion Pump

SERVICE MANUAL

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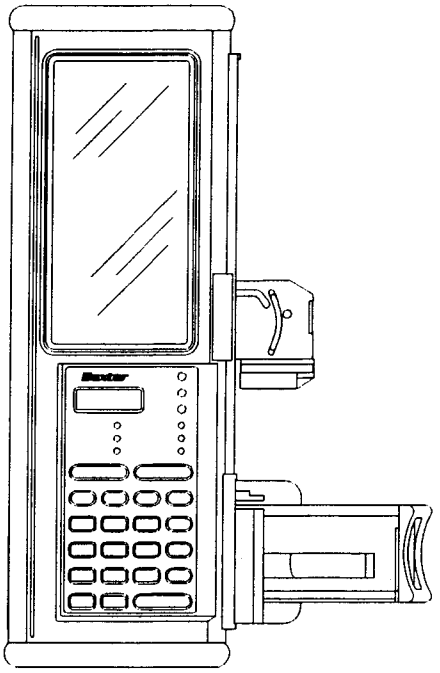

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1.1 GENERAL

This Service Manual has been developed to introduce the Biomedical Technician to the Auto Syringe® AS50 Infusion Pump (hereinafter referred to as "the pump"). This manual will provide a basic understanding of the internal workings of the pump, functional test procedures, assembly/disassembly instructions, troubleshooting, and a replacement parts list.

NOTE

Except for the procedures and replacement parts included in this document, no other disassembly or repair should be attempted.

Baxter Healthcare provides a one-year limited warranty for each Auto Syringe® AS50 Infusion Pump. If a pump requires warranty service, call Baxter Healthcare for repair. Unauthorized repair of a pump before the warranty has lapsed voids the warranty.

1.2 FACTORY SERVICE/ASSISTANCE

If factory service is desired, pumps may be returned to Baxter Healthcare for repair.

Please call for a return authorization number before shipping any pump to Baxter Healthcare.

1.2.1 Technical Assistance, Service, and Repairs:

For technical assistance, parts ordering, and service return authorization, contact the Baxter Healthcare Service Center:

1.2.2 Customer Service Related Business:

1-800-343-0366
Includes: Part orders and return/repair authorizations.

1.2.3 Technical Assistance Hotline:

1-800-634-4602
Includes: Parts identification, troubleshooting assistance and technical training schedules.

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2.1 MECHANICAL

2.1.1 Mechanical Drive Assembly

2.1.1.1 Overview

The Mechanical Drive Assembly provides several operational functions for the pump. In operation, this assembly:

1. Secures the syringe plunger and linearly pushes the plunger into the syringe barrel;

2. Senses whether the syringe plunger is captured properly;

3. Senses the linear position of the syringe plunger;

4. Is designed to function with 1 mL to 60 mL syringes from three different manufacturers.

Three screws attach the Mechanical Drive Assembly to the case. Two connectors (Drive Pot./Membrane Switch Berg connector and the Strain Gage connector) provide electrical paths to corresponding connectors on the analog printed circuit board located on the Cover. The other side of the Mechanical Drive Assembly has a flange that fits into a groove in the Cover.

2.1.1.2 Syringe Installation

The Mechanical Drive Assembly and the Barrel Clamp Assembly both serve to secure a syringe to the pump. Pulling the Slide out from the Mechanical Drive Assembly as far as it will go allows the plunger driver to be moved in either direction. With the barrel clamp open, the syringe flange is then inserted into the flange slot of the Barrel Clamp and the syringe plunger is inserted between the Face and Slide of the plunger driver.

2.1.1.3 Drivetrain

The Drivetrain consists of the Motor/Gearhead/Encoder Assembly (assembly includes a Micro-Mo DC Motor, a 485:1 Gearbox, and a 16 pulse per revolution encoder), and several other Drivetrain parts cited below.

At the motor end of the Drivetrain, two screws are used to attach the Motor/Gearhead/Encoder Assembly to the Motor Plate Assembly. The Motor Plate Assembly includes the Motor Plate, the Drive Seal, and an Oilelite Bearing. Using an adhesive, the Drive Seal is bonded to the Motor Plate and the Oilelite Bearing is slip fitted into the Motor Plate to accommodate one end of the Leadscrew.

The Load Plate Assembly, positioned at the other end of the Drivetrain, includes the Force Plate/Insert Assembly, the Force Plate Seal, and a Spherical Bearing. Using an adhesive, the Force Plate Seal is bonded to the Force Plate/Insert Assembly and the Spherical

Bearing is press fitted to the Force Plate/Insert Assembly to accommodate the other end of the Leadscrew.

A Shaft is attached to the Motor Plate Assembly and to the Force Plate/Insert Assembly using two screws. This shaft guides the Plunger Driver back and forth in its range of travel while helping to keep the Plunger Driver Assembly from rotating perpendicularly in relation to the direction of infusion travel. The Motor Plate Assembly and Force Plate/Insert Assembly are both locked to the Chassis. Finally, much of the Mechanical Drive Assembly is sealed with RTV. Rotational mechanics of the Drivetrain are as follows:

- Rotation of the Micro-Mo Motor turns a 22-tooth Gear attached to the Gearbox output shaft with a setscrew. Another 22-tooth Gear is attached to the Leadscrew shaft and meshes with the 22-tooth Gear on the output shaft. The gear on the Leadscrew shaft causes rotation of the Leadscrew.

- Movement of the syringe plunger results when the Leadscrew turns against the Halfnuts causing the Plunger Driver Assembly to traverse along the Leadscrew.

2.1.1.4 Plunger Capture Sensor

The Soft Pot Bracket Assembly and Drive Actuator Assembly contribute functionally to the Syringe Recognition process. The Soft Pot Bracket Assembly, consisting of a Drive Potentiometer attached to the Soft Pot Bracket, attaches with one screw to the Motor Plate Assembly and with two screws to the Load Plate Assembly. Tabs are located on both Motor Plate and Load Plate Assemblies for correct positioning and seating of the Soft Pot Bracket Assembly to both Motor Plate and Load Plate Assemblies. The Drive Actuator Assembly, consisting of a Wiper Spring assembled to the Wiper Support, rides in a "V" shaped slot in the Plunger Driver Carriage.

Two cams on the Plunger Driver Lever are used to position the Wiper Support. As the Lever rotates, the Drive Actuator Assembly will move back and forth in the Carriage V slot. When the Slide is closed (i.e. pulled by the Constant Force Spring all the way into the Mechanical Drive Assembly), the Lever Pin will end up being in the bottom of the short dogleg slot on the Plunger Driver Slide. When in either the long or short dogleg of the Slide, the Lever Pin causes the Lever to rotate in a manner such that the Lever's Wiper Support cams position the Wiper Support and the Wiper Spring a precise distance away from the Drive Potentiometer. The Wiper Spring has three leaf springs on it. The middle spring is the part of the Wiper Spring that can make contact with the Drive Potentiometer and cause it to activate. The two outer springs are used to push the Wiper Support and Wiper Spring away from the Drive Potentiometer. The Drive Potentiometer has two polyester layers that are conductive on one side and are separated by a thin polyester and adhesive spacer. When the Wiper Spring moves close enough to the Drive Potentiometer, the two Drive Potentiometer conductive layers come into contact causing the Drive Potentiometer to actuate. When the Slide is closed, the Wiper Spring moves away from the Drive Potentiometer and the middle Wiper Spring is not able to cause the Drive

Potentiometer to activate. Mechanics of the syringe plunger detection feature, including "Timing," are as follows:

- Syringe is Present Mode

When the syringe plunger is properly installed in the Mechanical Drive Assembly, the Lever Pin is in the straight portion of the slot on the Slide, the Drive Potentiometer will be activated by the middle spring of the Wiper Spring, and the pump will properly detect the presence of the syringe plunger. The Lever rotates in a manner causing the Lever's Wiper Support cams to position the middle spring of the Wiper Spring to make contact with and compress the two Drive Potentiometer layers together. Under these conditions, the Drive Potentiometer activates and the pump properly detects the presence of the syringe plunger.

- Syringe is Not Present Mode

When the syringe plunger is not installed in the Mechanical Drive Assembly, the Drive Potentiometer will not be activated by the middle spring of the Wiper Spring, the pump will detect that a syringe is not present, and an alarm will sound if an infusion is attempted.

- Timing

The timing for detection or non-detection of a syringe is fairly complex and thus requires precise parts. The total movement of the Wiper Spring from the state of no syringe present to syringe present is only .055 inch. Of the .055 inch movement, approximately .015 - .020 inches is required to compress the middle spring of the Wiper Spring sufficiently to generate enough spring force to cause the Drive Potentiometer top and bottom layer to come into contact causing activation of the Drive Potentiometer. The outer two springs of the Wiper Spring are for retracting the Wiper Support/Wiper Spring away from the Soft Potentiometer when a syringe plunger is not installed in the pump or is improperly installed in the pump.

2.1.1.5 Plunger Driver Assembly

The Plunger Driver Assembly holds and drives the syringe plunger. This assembly consists of the Upper Plunger Assembly, the Lower Plunger Assembly, and the Drive Actuator Assembly (refer to Syringe Recognition Sensor). The Lever Pin (see Syringe Installation and Syringe Recognition Sensor) secures the Upper Plunger Assembly to the Lower Plunger Assembly.

- Upper Plunger Assembly

The Plunger Driver Slide, used for capturing the syringe plunger, has two Finger Grips on it which the operator can easily grasp. One end of the Constant Force Spring is attached to the Upper Plunger Face by a Header Pin press fit to the Face. The opposite end of the Constant Force Spring is attached to the Spool which has a Stepped Pin going through it. The ends of the stepped Pin are inserted into holes on the Plunger Driver Slide. As the Slide is pulled opened or allowed to close, the Constant Force Spring spirals on or off the

Spool and the Slide traverses against the Plunger Driver Carriage found on the Lower Plunger Assembly.

- Lower Plunger Assembly

The Plunger Driver Lever rotates in the Plunger Driver Carriage on two Lever Screws that have precise diameters. The Lever Screws act as hubs for the Lever and secure the Lever to the Carriage. The Lever Pin is pressed into the Lever and Lever rotation is due to the movement of the pin in the Slide slot as the Slide is moved in and out. Two cams on the Lever move against two cam surfaces on the Face whenever the Slide is pulled out or released. As the Slide is pulled all the way out from the pump, the cams meet and push the Face away from the syringe plunger permitting the syringe to be easily loaded into the Plunger Driver Assembly.

Two Sleeve Bearings are press fit into the Carriage allowing the Plunger Driver Assembly to move freely on the Shaft. The Driver Actuator Assembly is designed to move freely in the Carriage. The Face is also designed to move freely against the Carriage.

The Lockplate is free to move in the V in the Carriage. There are two Compression Springs that push the Lockplate out of the Carriage to lock the two (left hand and right hand) Halfnuts shut. Two Retaining Rings secure the Halfnuts to Halfnut Pins that are press fit into the Carriage. The Halfnut rotates freely on these pins. The Halfnut Compression Spring pulls the Halfnuts together onto the Leadscrew. When driving a syringe, the design of the Plunger Driver Assembly causes the Halfnuts to grab onto the Leadscrew. The Lockplate is required to keep the Halfnuts closed.

2.1.2 Barrel Clamp Assembly

2.1.2.1 Overview

The barrel clamp assembly mounts externally onto the back of the pump case. The purpose of the barrel clamp is to secure the barrel of the syringe to the pump housing. The barrel clamp accommodates syringe barrels from three different manufacturers and of volumes from 1 mL to 60 mL. The "syringe recognition" feature measures the barrel outer diameter for recognition purposes. In addition, the barrel clamp must detect that the barrel is securely fastened and that the barrel flange is locked in place.

2.1.2.2 Major Components

The backbone of the barrel clamp is the clamp base. The syringe barrel is captured between the gray colored cradle and the clear plastic clamp face. The cradle is attached to the clamp base and the clamp face is attached to the barrel clamp slide. The slide is spring-loaded and extends outwards from the cradle. The slide is held against the base by the two retaining plates. The barrel clamp brake locks the slide in place against the force of the extension spring. The brake can be released by moving the primary release lever. The braking force is applied by the brake spring (compression spring). The primary

release lever may also be actuated by the secondary lever. The fit of the barrel clamp brake into the clamp base ensures that the brake releases automatically when the slide is pushed inwards. Hence, the release levers are only required to open the slide.

The syringe barrel flange is held against the cradle by the tablock bracket. The tablock bracket is raised or lowered by the rotation of the pendulum. One end of the pendulum rides in a slot in the barrel clamp slide. The other end of the pendulum raises the tablock bracket. The slot in the barrel clamp slide has a dogleg at one end that forces the pendulum to rotate about the pivot screw. When the slide is extended fully by releasing the brake, the dogleg forces the pendulum to raise the tablock bracket. When the slide is pushed in, the tablock bracket is clamped against the flange by the tablock spring (compression spring).

The barrel clamp switch assembly consists of a membrane switch assembly mounted onto a printed circuit board. The circuit board is mounted onto the two retaining plates by four switch adhesive pads and four retaining rings. The membrane switch assembly includes a membrane potentiometer (softpot) that is used to detect the position of the barrel clamp slide. The position of the slide in reference to the cradle is a measure of the syringe barrel diameter (syringe recognition). The actuator support, mounted onto the slide, holds the Teflon actuator button. The actuator button acts as the potentiometer wiper.

The rubber rocker seal protrudes from the cradle. Beneath the rocker seal lies the plastic rocker. When the syringe barrel is captured between the cradle and face, the rocker is pressed against the rocker spring (metal leaf spring). Two barrel sensing membrane switches, connected in series, are adhered onto the rocker spring. The rocker housing supports the rocker and the rocker spring.

The flange sensing switch, part of the barrel clamp switch assembly, detects the presence of the barrel flange. The switch is adhesive mounted onto the tablock bracket and is actuated by the pendulum. The switch is open when a flange is correctly positioned under the tablock and closed when there is no flange present.

The ESD torsion spring and ESD contact strip reduce the possibility of damage to the pump by Electro-Static Discharge (ESD). The torsion spring is located between the retaining plate and the barrel clamp base. Its axis is coaxial with one of the holes for the #4-40 barrel clamp mounting screws that connect the barrel clamp to the pump. The purpose of the torsion spring is to make electrical contact between the retaining plate and the #4-40 screw. The #4-40 screw is electrically grounded to the interior plating of the pump housing. The ESD contact strip is a beryllium copper leaf spring that fits between the retaining plate and the Primary Lever Pivot Screw (#6-32 x 1/4"). This contact strip electrically connects the primary lever assembly to the retaining plate.

The barrel clamp switches are connected to the I/O board inside the pump through the zebra strip. The zebra strip is a gold plated electrical connector that fits into a slot in the pump rear case. The zebra strip makes contact with six gold plated pads on the barrel clamp switch circuit board.

2.1.3 Pole Clamp Assembly

2.1.3.1 Overview

The main function of the pole clamp is to attach the pump securely to an IV pole. The pole clamp mounts onto the back of the pump and is held in place by tightening a small thumbscrew. The jaws of the pole clamp are tightened onto the IV pole by turning a knob.

2.1.3.2 Major Components

The pole clamp knob fits into a slot in the clamp. The clamp is hinged onto the pole clamp base. A threaded post, called the pole clamp screw, is connected to the clamp base with a roll pin. The knob threads onto the pole clamp screw and, when turned, causes the clamp to open or close on its hinge. The pole clamp base is connected by four screws onto the pole clamp cradle. The IV pole is clamped between the cradle and the clamp part. Two rubber bumpers glued to the cradle increase the friction between the pole and the cradle. The pole clamp cradle is connected to the pole clamp mounting plate with one screw. If this screw is removed, the cradle may be rotated 90 degrees and reconnected. This feature allows the pole clamp to mount onto horizontal or vertical IV poles. The pole clamp mounting plate has an integral mounting screw which is hand tightened to connect the pole clamp to the pump.

2.1.4 IV Pole Loop

2.1.4.1 Overview

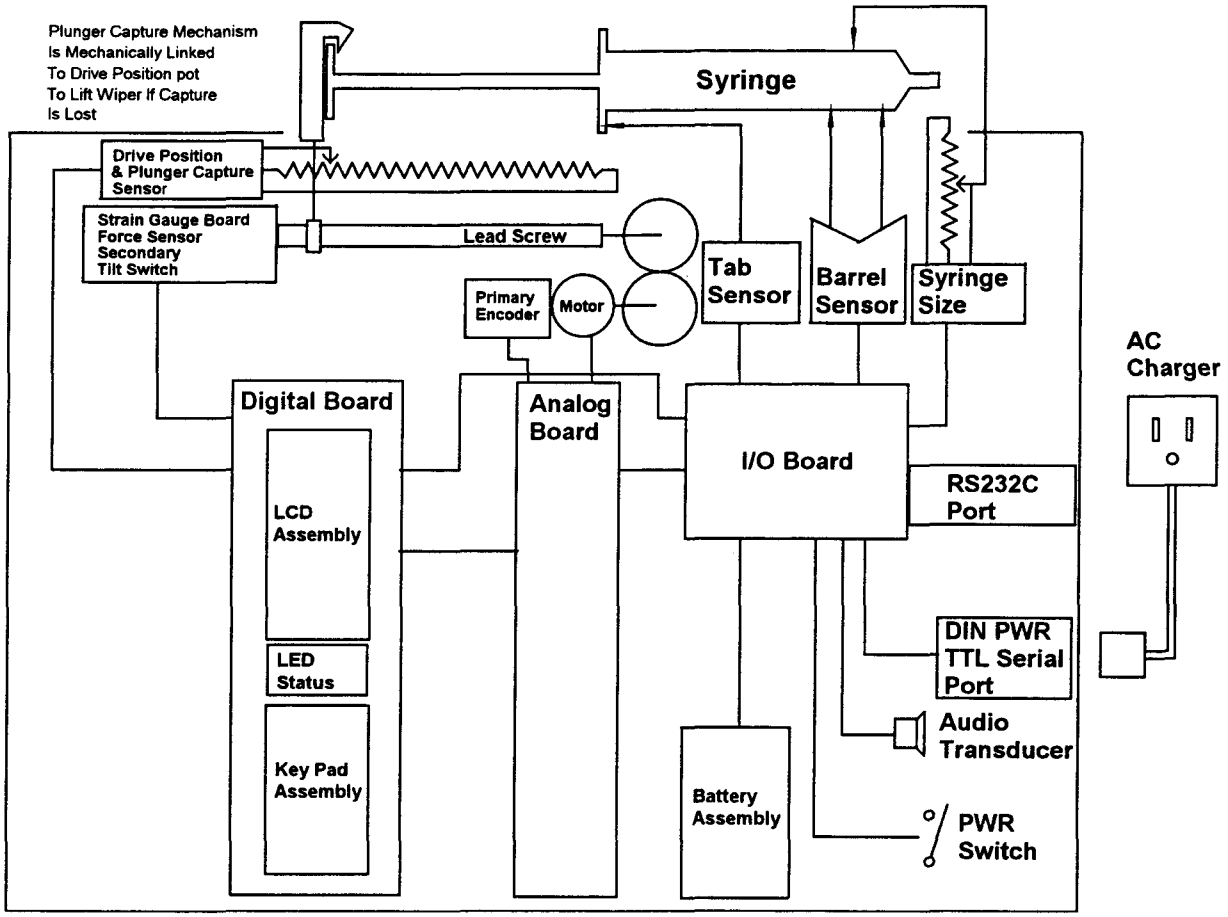
The main function of the IV Pole Loop is to allow the pump to hang from a hook on an IV pole. This loop folds down when not in use, or may be swiveled as required.

2.1.4.2 Major Components

The pivot ring is the loop that allows the pump to hang from an IV Pole. The pivot ring is attached to the pivot retainer which is allowed to rotate about the pivot mount. The pivot mount is attached with a screw to the loop mounting plate. The loop mounting plate slides into grooves in the case and cover during final assembly.

2.2 ELECTRICAL

2.2.1 General System Block Diagram



2.2.2 General Description

The Auto Syringe® AS50 Infusion Pump is a computer controlled syringe driving infusion pump.

A side mounted switch controls the power to the system.

The pump controls the rate of advance of the syringe plunger via program parameters. Program parameters are entered via a keypad, TTL serial port or RS-232-C serial port and displayed on the LCD. Operational status is reported on the LCD, the LED status indicators and by the Audio Transducer.

Syringe capture is determined by three separate sensors. The barrel sensor is made up of two switches under the rubber pads in the barrel clamp cradle. Both switches must be closed to detect the barrel presence. The syringe tab is sensed by the barrel clamp which

closes a switch when the flange is not present. Plunger capture is determined by a mechanism that lifts the wiper on the plunger drive potentiometer if the plunger is not properly captured, this open circuits the potentiometer.

The syringe size is determined by a linkage between the barrel clamp and a potentiometer that enables the pump to determine the size of the syringe installed.

The progress of the infusion is monitored by a number of sensors. There are three separate sensors to monitor the advancement of the plunger. The primary encoder measures the movement of the rotor of the DC motor that drives the lead screw. The secondary encoder monitors the rotation of the lead screw. The tertiary encoder is accomplished by monitoring the plunger drive potentiometer, it determines if the plunger drive mechanism is advancing properly.

Motor control is monitored and controlled by a careful interaction between the master and slave CPU's and associated fail-safe logic circuitry.

The occlusion pressure is determined indirectly by measuring the pressure applied to the plunger of the syringe by measuring the reaction force on the lead screw via a strain gauge force measuring system. A tilt switch is used to detect and compensate for the vertical attitude of the pump for small diameter syringes.

Power is provided by a 5 cell battery pack. The pack is charging when the AC Charger is present. The battery pack must be present as the device is not intended to be operated on AC power alone.

2.2.3 Syringe Barrel Clamp

2.2.3.1 Syringe Barrel Diameter

Syringe barrel diameter is sensed by a mechanical linkage of the barrel clamp to a soft pot on the syringe holder mechanism. This signal passes through the zebra strip connector to the I/O board to the digital board as "SYR_SIZE" at P2A-3. This signal is filtered by R40 and C27 to a frequency of 125 KHz.

2.2.3.2 Flange Detector

Syringe flange detection is provided by a membrane switch in the barrel clamp assembly. The signal comes through the zebra strip connector to the I/O board to the digital board on P2A-1 as "FLANGE*" and is pulled up to +5V by R50.

NOTE

Signal lines followed by an asterisk indicate a logical NOT of the signal, or the signal becomes true when logically low and false when logically high.

2.2.3.3 Barrel Position Detector

Barrel position detection is provided by two membrane switches connected in series in the barrel clamp assembly. Each switch is activated by pressure of the syringe barrel on its respective half of the barrel cradle. Both switches must be activated to bring "BARREL*" low. This signal passes through the zebra strip connector to the I/O board to the digital board on P2A-2 as "BARREL*".

2.2.4 Syringe Plunger Position and Capture Detector

2.2.4.1 Plunger Position

Syringe plunger position is detected by linking the plunger driver to a soft-pot in the plunger driver mechanism. The system provides power and receives signal from the soft-pot via J7. The soft-pot wiper is named "LINEAR_POS" on the digital board.

2.2.4.2 Plunger Capture

Syringe plunger capture is detected by a mechanism in the plunger driver that disengages the wiper from the soft-pot when the syringe plunger is not properly engaged in the driver. When this happens R59 will pull "LINEAR_POS" to 0 volts which software then detects as loss of plunger capture.

2.2.5 Motor/Gearbox/Encoder

The pump makes use of a Micro-Mo DC Micromotor series 1524 with integral encoder and gear box part number 1524E006S123 155 485:1 HEM1524E16. It is a 6.0 volt 0.81 watt brushed motor with a 16 pulse per revolution encoder and a 485:1 gear box.

2.2.6 Audio Transducer

The audio transducer is a piezo ceramic transducer. It is driven at either 4 kHz for normal tones or an oscillating 4 kHz to 2 kHz for fail-safe alarms. The control and drive circuitry for the transducer is located on the analog board and is routed to the speaker via the I/O board.

2.2.7 Charger

The Charger C-AS40-01-900 is an unregulated wall plug transformer. It is specified as a nominal output of 12.6 volts peak at a load current of 250 mA with 115 VAC input. It behaves as a simple 16.1 volt source in series with a 13.5 ohm resistor with a nominal 115 VAC input.

2.2.8 Battery Pack

The battery pack of the pump is a 5 cell 1.5 amp hour Nickel Metal Hydride pack. This gives it a nominal 6 volt operating voltage. Actual battery voltages range from a high of 7.4 volts to 6.1 volts at the low battery threshold. Depleted battery threshold is defined as 5.5 volts. There are two parallel connections to the battery pack via the four pin connector. The Battery + and Battery - leads terminate at P12-1(+) and P12-2(-) of the I/O board.

2.2.9 Strain Gauge Board

2.2.9.1 Strain Gauge Amplifier

- First Stage

U1A provides amplification of the strain gauge signals via an amplifier configuration that uses the gauge as part of the amplifier. R1 sets the gain of this circuit along with the absolute value of the gauge resistance.

- Second Stage and Zero Adjustment

R2, R3 and U1B provide a second gain stage along with an offset adjustment. The offset adjustment is provided by R100.

- Output Range

The output at P4-5 is designed to be within the range of 0.3 volts to 4.7 volts corresponding to -2.5lbf to 22.5lbf of force on the gauge. Voltages outside of this range indicate either failure of the circuit or gauge or that the sensor test has been activated.

- Sensor Test

The sensor test is accomplished by pulling P4-1 to ground (on the digital board). This connects R4 across the bridge and provides a nominal -1.15 lbf delta on the output. During a test P4-5 may go lower than 0.3 volts if the input is at or near the -2.5lbf.

2.2.9.2 Secondary Encoder

U2 and U3 are Hall effect sensors 180 degrees out of phase that detect a magnet on the end of the syringe driver lead screw. They provide the secondary channel of detection for lead screw motion. Two devices are used so that a check can be performed more than once per revolution of the lead screw.

2.2.9.3 Hg Switch

S2 is a mercury switch for monitoring of the attitude of the pump. This signal is used to compensate for the mass of the lead screw assembly when using small diameter syringes.

2.2.10 I/O Board

The I/O board contains the interface to external electronics for the pump. This includes the battery charge control circuitry and the serial data interfaces.

2.2.10.1 Power Source

- Battery Charger

The battery charger circuit provides a tapered charge of the battery pack.

2.2.10.2 Zebra Strip Pass Through

J10 provides pads on the circuit board for connection to the zebra strip connector to the Syringe Clamp. These signals pass through and connect to J2.

2.2.10.3 Speaker Pass Through

The speaker is connected to J15-1 and J15-2 on the I/O board. These signals pass directly to J2-23 and J2-24.

2.2.10.4 Real Time Clock Power

The real time clock is always connected to the battery of the pump via the net "F_VB". It gets its power after the fuse F2 and feeds to the Analog board on J2-21.

2.2.10.5 Serial Port

The I/O board provides two different means for serial communication to the pump. It provides a TTL level connection via the 8 pin DIN connector on the bottom of the pump or a DB-9 connector with RS232 level serial signals on the back of the device. Software configuration is required to enable or disable either serial port.

- TTL Level (DIN Connector)

The TTL level serial port can be used for monitoring and control of the pump. It is also used to program the flash memory via the master bootstrap loader program.

J11-0 is a electromagnetic shield chassis ground.

J11-1 is the "Charger+(IN)" connection. It is ESD protected by Z3 and C3.

J11-2 is "RXD(IN)." This line is protected from ESD via R20, Z8 and C8. It is pulled down by R5 and isolated by R6 into U3C-7. From U3C-6 it passes through U4B to connect to "RS232_RXD" on J2-7.

J11-3 is "TXD(OUT)." It is ESD protected by R21, Z7 and C7. It comes from U3B-4 which buffers the signal "RS232_TXD" from J2-6.

J11-4 is "RTS*(OUT)." It is ESD protected by Z6 and C6. It comes from U3D-10. U3D-9 connects to "RTS*" via J2-8.

J11-5 is "CTS*(IN)." It is ESD protected by Z5 and C5. It is pulled up to +5V by R7 and isolated by R8 into U3E-11. From U3E-12 it goes through MUX U4C-8 to U4C-9 to CTS* on J2-9.

J11-6 is "VPP[12V] (IN)." It is ESD protected by Z3 and C3. It is pulled low by R4. It provides the programming voltage for the FLASH memory and controls the "MAS_EA*" line of the master CPU.

J11-7 is not connected.

J11-8 is the "CHARGER-(IN)." It is ESD protected by Z2 and C2.

- RS-232-C (DB-9 Port)

The RS-232-C communication port is provided for monitoring and control of the pump. The pump's configuration is also downloaded via this port. RS-232-C communication is facilitated by U5. It is a self contained voltage generating serial port. It takes the +5 volt supply and makes +9V and -9V using capacitors C16, C17, C14, and C15. The device is controlled by "EIA_IN" from J2-11. This control line shuts down the voltage converters and puts the device in a low power state with tri-stated outputs. This control line also acts to disconnect the active inputs from CMOS inputs on J11. The signal outputs are always present on the CMOS output even in RS232 mode. The signal inputs are selected by the "EIA_EN" which controls U5-18, the "ON/OFF" input.

U4A is configured as an inverter to invert the active level of "EIA_EN" to operate MUX's U4B and U4C.

J14-1 is an NC.

J14-2 is "TxD" and is ESD protected by R15, C22 and U6B.

J14-3 is "RxD" and is ESD protected by R14, C21 and U6A.

J14-4 is an NC.

J14-5 is connected to "GND".

J14-6 is an NC.

J14-7 is "RTS" and is ESD protected by R16, C23 and U6C.

J14-8 is "CTS" and is ESD protected by R17, C24 and U6D.

J14-9 is an NC.

- VPP[12V](IN)

J11-6 is "VPP[12V](IN)". It is ESD protected by Z1 and C1. C9 provides filtering of line transients. The VPP line is terminated to ground by R4 and isolated from U3F-14 by R9. U3F-15 provides the signal "MAS_EA*" to J2-5. This line provides the programming voltage for reprogramming the FLASH memory of the device.

2.2.11 Analog Board

2.2.11.1 Motor Drive Electronics

- H-Bridge drive electronics

The motor drive on the pump is accomplished by a MOSFET H-Bridge Power amplifier comprised of Q6, Q7 (PMOS), Q8, Q9 (NMOS).

2.2.12 Digital Board

The digital board contains most of the digital circuitry for the pump including its microprocessors.

2.2.12.1 Keyboard Interface

The keypad is a matrix of switches created by a sandwiched array of silver polyester circuits and an elastomer cover. The switch functions of the keypad are arranged as follows:

	Col 3	Col 2	Col 1	Col 0
Row 0	"7"	"8"	"9"	"BOLUS"
Row 1	"4"	"5"	"6"	"EDIT"
Row 2	"1"	"2"	"3"	"LOCK"
Row 3	"0"	"."		"CONFIRM"
Row 4		"START"	"STOP"	
Row 5	"Δ"	"∇"	"PURGE"	"CLR"

The keyboard is scanned under software control via U11-PB0 to U11-PB5 for the row scanning. The columns are scanned via U12-P1.0 to U12-P1.3. No switches are present at the shaded sections of the table.

2.2.12.2 LED Status Indicators

The LED status indicators are located above the keypad. They provide an alternate method of communication between the user and the pump.

- "RUN", "STANDBY", "LOCK", "ALERT", "BATTERY"

There are three "RUN" LEDs as well as the "STANDBY", "LOCK", "ALERT" and "BATTERY" LEDs. They have different behavior modes depending on the mode of operation of the pump. They are controlled by the master CPU through the "I2C_2" serial interface bus and U10.

- "SYSTEM"

The "SYSTEM" LED is controlled in a manner similar to the other LEDs except that it is also controlled by the line "SYS_FS*" from the fail-safe latch logic. It is lit whenever the fail-safe latch is in the set state.

- "ON CHARGE"

The "ON CHARGE" LED is controlled under master CPU control through U11-PC2 "CHRG_LED" for the purposes of lamp test. It is also powered by the presence of charging voltages from the battery charge regulator via "CHARGER+". It gives an indication of the charger being active.

2.2.12.3 Syringe Drive Potentiometer Position and Capture Detector

J7 connects the digital board to the Drive Potentiometer Position Sensor. The signal "LINEAR_POS" is used by the master CPU to determine proper drive movement, end of syringe and near end of syringe alerts and syringe plunger capture. This signal is calibrated by using a series of gages in the syringe drive mechanism with the pump in calibration mode.

Plunger capture is performed by mechanically lifting the potentiometer wiper when the syringe plunger is not captured in the plunger driver. R59 will then pull the "LINEAR_POS" signal immediately to zero volts indicating a loss of plunger capture.

Proper drive movement is accomplished by an algorithm that assures that the LINEAR_POS signal does progress according to the movement that is expected from the primary and secondary lead screw encoders. This is a tertiary check on the movement of the syringe plunger and also assures that the plunger drive mechanism has properly captured the lead screw with the half nuts.

2.2.12.4 Sensor Power

The sensor power of the pump is controlled from U11-19, "SENSOR_PWR*". It controls the gate of Q1 a P-Channel MOSFET. The sensor power on the system is switched on and off to conserve power, especially at low delivery rates.

2.2.12.5 Liquid Crystal Display

The LCD display is a custom made STN transflective LCD display panel with alpha-numeric fields and fixed enunciators. The display is connected to the digital board through two elastomer zebra strip connectors. The digital board contacts are gold plated to enhance the reliability of this connection. It is held in place by the LCD frame assembly.

2.2.12.6 LCD Display Driver

The LCD segments are driven by U1 through U3 which is programmed through the "I2C_2" serial interface bus.

- LCD Contrast Circuit

U22 buffers a voltage generated by R14 and R15 to generate a voltage to bias "VLCD" on U1 through U3. This voltage controls the potentials provided to the LCD display segments.

- Backlight Current Controller

U12, Q3 and associated components provide a current source to drive the backlight LEDs D12 and D13. The backlight current is controlled by the master CPU by "BL_EN" either on or off. The LEDs are Ultra Bright reddish orange devices that shine light into the fiber optic backlight panel. The backlight is diffused up through the LCD panel by this fiber optic device to provide an even panel backlight.

2.3 SOFTWARE

2.3.1 Sensor Calibration

Sensor calibration modes include Calibration Review mode and Calibration Set mode. See Chapter 5 for complete instructions regarding sensor calibration.

2.3.1.1 Calibration Review Mode

Calibration Review mode allows review of the calibration settings without the risk of altering them.

Calibration Review mode allows the operator to review the following sensor calibration settings (in the following sequence):

1. Plunger Driver Position Sensor
2. Syringe Recognition Sensor
3. Pressure Sensor
4. VB_SENSE

In addition, Calibration Review mode provides an auxiliary LCD test for examining each LCD segment individually.

2.3.1.1.1 Activating Calibration Review Mode

To activate Calibration Review mode press the key sequence 3,2,1 following completion of the **POST** (Power-on Self Test).

2.3.1.1.2 Calibration Review Sequence

1. Plunger Driver Position Calibration Review

During plunger driver position calibration review, the pump continuously displays the analog and digital plunger driver position sensor readings, based on the current calibration settings. The text field displays **DRIVEPOS**.

Press CONFIRM to continue. The pump clears the readings, and continues with the syringe recognition calibration review.

2. Syringe Recognition Calibration Review

During syringe recognition calibration review, the pump continuously displays the analog and digital barrel clamp position sensor readings, based on the current calibration settings. The text field displays **SYRNGREC**.

Press CONFIRM to continue. The pump clears the readings, and continues with the pressure sensor calibration review.

3. Pressure Sensor Calibration Review

At the start of the pressure sensor calibration sequence the text field displays **PRESSENS.** The pump begins stepping the motor. After approximately 5 seconds, the digital pressure sensor reading is continuously displayed, and the reading is updated with each motor step.

NOTE

The motor will not operate and no reading will be displayed unless the plunger capture sensor indicates the presence of a syringe plunger or equivalent.

Press CONFIRM to continue. The pump clears the readings, and continues with the VB_SENSE calibration review.

4. VB_SENSE Calibration Review

During VB_SENSE calibration review the pump continuously displays the analog and digital VB_SENSE readings, based on the current calibration settings. The text field displays **VB_SENSE**.

Press CONFIRM to continue. The pump clears the readings, and continues with the auxiliary LCD test.

5. Auxiliary LCD Test

The pump allows a detailed test of the LCD for segment shorts and opens. To perform the auxiliary LCD test, place the pump in Calibration Review mode.

Following review of the battery sensor calibration display, the text field displays **TEST LCD**. **N** is displayed in the Syringe mfr field. To start the Auxiliary LCD Test, press ▲ or ▼ to change the **N** to **Y** and press CONFIRM. [If CONFIRM is pressed while **N** is displayed, the pump exits calibration review mode and restarts the **POST**.

The LCD is initially blanked. Each segment in the top line of the LCD is then turned on for 1/4 second, starting with the **SYRINGE mfr/size** annunciator on line 1, and proceeding from left to right through each segment to the last segment on the line. When the last segment has been displayed, the test repeats with the first segment of the same line. To proceed to the next line, press CONFIRM at any time. Each time CONFIRM is pressed, testing begins on the next line, rolling over from the bottom line to the top line.
Press STOP to terminate the test and restart the **POST**.

2.3.1.1.3 Aborting Calibration Review

Calibration review may be aborted at any time by turning off the pump.

2.3.1.1.4 LED Indications During Calibration Review

During Calibration Review, the LEDs indicate the following:

- The **ALERT** LED is on when the pump is vertical.
- The **BATTERY** LED is on when the plunger capture detector is detecting a syringe plunger.
- The **STANDBY** LED is on when the flange sensor is detecting a syringe flange.
- The **LOCK** LED is on when the barrel sensor is detecting a syringe barrel.

2.3.1.2 Calibration Set Mode

Calibration Set mode provides the following calibration functions (in this sequence):

1. Calibrate Plunger Driver Position Sensor
2. Calibrate Syringe Recognition Sensor
3. Calibrate Pressure Sensor
4. Calibrate VB_SENSE

2.3.1.2.1 Activating Calibration Set Mode

To activate Calibration Set mode press the key sequence 5,0,8,9 following completion of the **POST**.

NOTE

The pump sounds an error beep for each key. These tones are provided to discourage unauthorized access and may be ignored.

Following the software version display, the pump proceeds with the plunger driver position sensor calibration sequence.

2.3.1.2.2 Calibration Set Sequences

NOTE

If Calibration Set mode is entered following a CHARGE DEPLETED, FUSE FAILURE, or POWER FAULT alarm, the pump will skip directly to the VB_SENSE calibration step.

1. Plunger Driver Position Calibration

This is accomplished by using calibration standards to input two drive position locations to the pump. The software then utilizes these two reference locations to complete the driver position calibration. With this information, the pump is then able to determine the distance between the plunger driver and the barrel clamp.

2. Syringe Recognition Calibration

This is accomplished by using calibration standards to input two barrel clamp positions to the pump. The software then utilizes these two reference positions to complete the syringe recognition calibration. With this information, the pump is then able to recognize syringe barrel diameters as part of its syringe recognition feature.

3. Pressure Sensor Calibration

This is accomplished by providing input to the pump while hanging a 10 lb. calibration standard on the plunger driver then providing similar input when there is no load on the plunger driver. The software then utilizes these two reference points to complete the pressure sensor calibration. With this information, the pump is then able to recognize pressure values applied to the plunger driver.

4. VB_SENSE Calibration

This is accomplished by using a variable power supply to provide two references points to the pump at 7.5 V and 5.5 V. The software then utilizes these two reference points to complete the VB_SENSE calibration. With this information, the pump is then able to recognize battery voltage values.

2.3.1.2.3 Aborting a Calibration Sequence

For each sensor calibration sequence, new settings are not saved until **UPDATING** is displayed. Turning off the pump prior to the **UPDATING** display aborts the sequence and leaves the original settings unchanged.

CAUTION

To prevent corruption of the calibration data, do not turn off the pump or press any key while UPDATING is being displayed.

2.3.1.2.4 LED Indications During Calibration

At the beginning and end of each sensor calibration sequence (before and after the portion of the sequence in which the standards are read), the LEDs indicate the following:

1. The **ALERT** LED is on when the pump is vertical.

2. The **BATTERY** LED is on when the plunger capture detector is detecting a syringe plunger.
3. The **STANDBY** LED is on when the flange sensor is detecting a syringe flange.
4. The **LOCK** LED is on when the barrel sensor is detecting a syringe barrel.

2.3.2 Configuration Replication

The Configuration Replication feature allows the entire configuration file including protocol libraries and the library access code to be copied from one pump (the source pump) directly to a second pump (the destination pump). This permits replication of configuration information from a master pump to multiple pumps.

2.3.3 System Configuration

System configuration modes include **Configuration Review** mode and **Configuration Set** mode. See Chapter 8 for complete instructions regarding system configuration.

2.3.3.1 Configuration Review Mode

Configuration Review mode allows review of configurable options without risk of altering them.

2.3.3.1.1 Activating Configuration Review Mode

To activate Configuration Review mode, press the key sequence 1,2,3 following completion of the **POST**.

2.3.3.1.2 Configuration Review Sequence

Following the software version display, the pump prompts for each group of review options by displaying **VIEW <group name>**. **Y** is displayed in the syringe manufacturer field. To access the indicated option group, press **CONFIRM**. To skip to the next group press ▲ or ▼ to change the **Y** to **N** and press **CONFIRM**. Continue to press **CONFIRM** to view each option in a group until the next group prompt appears. Again, use the ▲ or ▼ key to view that group's options.

When the last configuration group option has been reviewed, the pump automatically restarts the **POST**. Also, switching the pump **"OFF"** any time during the review will cancel the review process.

2.3.3.2 Configuration Set Mode

Configuration Set mode is primarily used to select and control configurable options, and provides the following functions:

- create, modify and delete protocol libraries, and control availability of specific protocol libraries
- create, modify and delete protocols
- control access to LIBRARY group functions
- transfer (replication) configuration from pump to pump
- control availability of specific infusion modes
- control availability of specific syringe manufacturers
- control availability of specific syringe sizes
- enable/disable "Default to Previous" feature for protocol library, protocol, mode, and syringe manufacturer
- enable/disable Remote Control feature
- enable/disable Protocol Library feature
- enable/disable Size Override feature
- control occlusion detection sensitivity
- control audio volume range
- control maximum rate of infusion
- enable/disable Auto Lock feature
- enable/control/disable backlight
- select serial port
- enable/disable PUMP IS IDLE alarm feature
- enable/control/disable Near End alert
- enable/disable BOLUS COMPLETE alert
- enable/disable DOSE COMPLETE alarm
- enable/disable Volume Limit feature for ML/HR and ML/MIN modes
- define alphanumeric identifier
- set date/time feature

2.3.3.2.1 Activating Configuration Set Mode

To activate Configuration Set mode press the key sequence 9,8,0,5 following completion of the **POST**.

During the Configuration Set mode, the screen will display [UPDATING] at various times to store the currently requested changes.

CAUTION

To prevent corruption of the configuration data, do not turn off the pump or press any key while UPDATING is being displayed.

2.3.3.2.2 Date and Time Display

On entry to Configuration Set mode, the pump initially displays the date and time, in the following format:

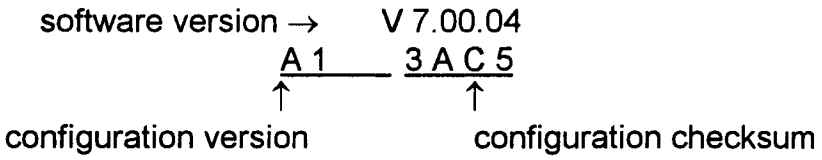
12.00AM
12/13/95

2.3.3.2.3 Software Version Display

Following the date and time display, the pump presents the software version display.

The first line of the text display indicates the pump software version. The second line is divided into two fields. The left field displays the configuration version, a 2-character code that identifies the format of the configuration data. The right field displays the 4-character configuration checksum, which identifies the entire current configuration file including the protocol library.

The following example shows a software version display for software version 7.00.04, configuration version A1 and configuration checksum 3AC5.



This configuration information allows a high-confidence rapid comparison of configuration files between two pumps.

2.3.3.2.4 Configuration Set Sequence

Following the software version display, the pump prompts for each group of configuration options by displaying **CONFIG <group name>**. **Y** is displayed in the syringe manufacturer field. To access the indicated option group, press CONFIRM. To skip to the next group press ▲ or ▼ to change the **Y** to **N** and press **CONFIRM**.

Unless otherwise indicated below, options within a group are displayed in a similar way. Each option is identified in the text field and a flashing **Y**, **N** or other character in the syringe manufacturer field indicates the current configuration of the option. The ▲ and ▼ keys may be used to toggle among the configuration choices and CONFIRM is pressed to complete the setting and proceed to the next option.

When the final option within a group has been configured, the pump displays **UPDATING**, then the configuration sequence proceeds to the next **CONFIG <group name>** prompt. The pump restarts the power-on self test (POST) following the final **UPDATING** display.

CAUTION

To prevent corruption of the configuration data, do not turn off the pump or press any key while UPDATING is being displayed.

2.3.3.3 Configuration Groups

The pump supports eight configuration groups including:

1. LIBRARY Group
2. MODES Group
3. SYRINGES Group
4. DEFAULTS Group
5. MISC (Miscellaneous) Group
6. ALERTS Group
7. CLOCK Group
8. IDENT (Identifier) Group

All groups may be selected for edit or review. In the "Configuration Set" mode, the pump's configuration may be modified by enabling or disabling any option offered within each group. In the "Configuration Review" mode, the pump's configuration cannot be modified and group options may be reviewed but not altered.

2.3.3.3.1 LIBRARY Group

The LIBRARY configuration group allows the operator to perform pump-to-pump configuration replication; to create, modify or delete protocol libraries; or to create, modify or delete protocols.

2.3.3.3.2 MODES Group

The MODES configuration group allows the operator to individually enable and disable any of the following 18 infusion modes:

1. ML/MIN
2. ML/HR
3. MUNITS/MIN
4. MUNITS/HR
5. UNITS/MIN
6. UNITS/HR
7. SINGLE DOSE
8. MANUAL SCHEDULE
9. AUTO SCHEDULE
10. MCG/MIN
11. MCG/HR
12. MG/MIN
13. MG/HR
14. MCG/KG/MIN
15. MCG/KG/HR
16. MG/KG/MIN
17. MG/KG/HR
18. CUSTOM DILUTION

2.3.3.3.3 SYRINGES Group

The SYRINGES configuration group allows the operator to individually enable and disable various syringe manufacturers and/or syringe sizes offered by them. This group, as follows, contains three syringe manufacturers each offering seven syringe sizes:

B-D®	**Monoject®**	**Terumo®**
1 mL Plastic	1 mL Plastic	1 mL Plastic
3 mL Plastic	3 mL Plastic	3 mL Plastic
5 mL Plastic	6 mL Plastic	5 mL Plastic
10 mL Plastic	12 mL Plastic	10 mL Plastic
20 mL Plastic	20 mL Plastic	20 mL Plastic
30 mL Plastic	35 mL Plastic	30 mL Plastic
60 mL Plastic	60 mL Plastic	60 mL Plastic

NOTE

At least one syringe manufacturer must be enabled.

2.3.3.3.4 DEFAULTS Group

DEFAULTS group options affect the way the pump initializes certain programming selections when ▲ or ▼ is pressed. Four default options are available:

1. DFAULT LIBRARY
2. DFAULT PROTOCOL
3. DFAULT MODE
4. DFAULT MFR

2.3.3.3.5 MISC Group

Nine options are available within the MISC (miscellaneous) group. They include:

1. REMOTE CONTROL
2. LIBRARY
3. SIZE OVERRIDE
4. PSI RANGE
5. AUDIO RANGE
6. RATE RANGE
7. AUTO LOCK
8. BACKLITE
9. ENABLE DB9 PORT

2.3.3.3.6 ALERTS Group

The ALERTS group includes the following five options:

1. IDLE ALARM
2. SET NEAR END
3. BOLUS COMPLETE
4. DOSE COMPLETE
5. VOLUME LIMIT

2.3.3.3.7 CLOCK Group

The CLOCK group, although not part of the configuration group, allows the operator to set the real-time clock during the configuration process.

2.3.3.3.8 IDENT Group

The IDENT group, although not part of the configuration group, allows the identifier (short message of up to eight characters) to be edited during the configuration process. During that process, the operator is allowed to select an alphanumeric identifier (default identifier is "AS50") of up to eight characters to be displayed following the 'off' portion of the lamp test.

2.3.4 Specific Features

2.3.4.1 Serial Communication Feature

The serial communication feature includes remote *monitoring* and *control* functions. A DB9 connector allows an RS-232(C) communication link between the pump and a host computer. The feature will allow an operator at a remote computer to control pump operations and to query the pump for infusion totals, program data and operational status.

The remote *monitoring* function is available whenever the pump is in operation.

The remote *control* function is available during normal operation if it is configured to **REMOTE CONTROL.**

A **REMOTE CONTROL** option has been added to the MISC configuration group for this purpose. When the **REMOTE CONTROL** feature is configured, the pump will display "**REMOTE CONTROL**" as the first prompt immediately following the Power-On Self Test (POST).

An **ENABLE DB9 PORT** option is added to the MISC configuration group. Choices will be **"Y"** or **"N"**. A **"Y"** choice will enable the DB9 connector as the serial I/O port. **"N"** will select the Mini-DIN connector.

Complete remote monitoring and control application information is provided in the Auto Syringe® AS50 Infusion Pump Programmer's Manual.

2.3.4.2 Event Recording Feature

The pump has the capability of recording 253 events in EEPROM. The pump maintains two separate logs: the event log and the fail-safe log. The event log has a capacity of 243 events and the fail-safe log, 10 events. Each log is maintained as a circular list; that is, when the log is full, the oldest event is replaced with the next event. The logs are defined and accessed by way of the serial port using instructions outlined in the Auto Syringe® AS50 Infusion Pump Programmer's Manual.

2.3.4.2.1 Dumping the Event Log

The Serial Communication Feature will provide remote commands for transmitting the contents of the fail-safe alarm log and the event log to a host computer. Refer to the Auto Syringe® AS50 Infusion Pump Programmer's Manual for additional information.

2.3.5 Displaying Additional Program Data

The following sequence will be followed when CONFIRM is pressed either during Run or Standby state to display additional data:

1. The battery voltage will be displayed in the text field for 3 seconds.
2. Next, the operating mode will be displayed in the text field for 3 seconds.
3. The normal display will be restored.

NOTES

If the pump is in Run state, the SYRINGE mfr/size field will be displayed during steps 1 - 3.

If the pump is in CUSTOM DILUTION mode, the original drug concentration, FINAL VOL and DRUG VOL fields will be displayed during steps 1 - 3.

Pressing any key during the above sequence will abort the sequence and restore the normal display.

2.3.5.1 Battery Voltage Display

The battery voltage will be displayed when **CONFIRM** is pressed for displaying additional program data. Line 1 of the text field will display the voltage (for example "7.0 V"). Line 2 will display BATTERY.

If the **CONFIRM** key is pressed during the lamp test portion of the **POST**, the battery voltage will be displayed for two seconds immediately following the lamp test.

2.3.6 Specific Errors, Codes, and Alarms

2.3.6.1 Error Trap Numbering

Pump fail-safe errors that are displayed as codes are assigned fixed numbers.

Master processor fail-safe error codes will be displayed as **ERROR M**<code>, where <code> is a six digit number (for example, **ERROR M000215**).

Slave processor fail-safe error codes will be displayed as **ERROR L**<code> where <code> is a six digit number (for example, **ERROR L000180**).

2.3.6.2 Lost Library Access Code

In the event a library access code is lost, contact the Andover Service Center for retrieval instructions.

2.3.6.3 Changing RATE in Concentration Modes

Allows the operator to edit either **RATE** or **DOSE** during delivery in all modes for which a concentration and a dose are programmed except for **CUSTOM DILUTION** mode.

If a RATE value is selected for which the equivalent DOSE value is out of range for the LCD (< .0001 or > 9999.), a **PUMP LIMIT** error response, is provided, displaying the nearest acceptable **DOSE** (.0001 or 9999.) value and its equivalent rate.

2.3.6.4 Allow Restart After Empty Alarm

Because of mechanical tolerance allowances and variations in syringe hard height (length of empty syringe with the plunger bottomed out), a residual volume of drug may remain in the syringe when the pump detects the Empty position.

The pump will allow the operator to restart delivery after an Empty alarm. The pump will continue to display the alarm text ("EMPTY" or "EMPTY <protocol>") and the ALERT LED will continue flashing. The pump will continue in Run state until it is manually stopped by the operator, or until an Occlusion alarm occurs.

2.3.6.5 Syringe Pop-Out Detection

The pump will provide a syringe pop-out check during Run, Bolus and Purge delivery. The pump will issue a **CHECK BARREL** alarm (assuming only the barrel clamp state is invalid) if the apparent barrel diameter reaches or exceeds [approx. 1/8 inch] over the maximum barrel diameter for the programmed syringe size.

2.3.6.7 CHARGE DEPLETED Alarm

If a **CHARGE DEPLETED** alarm occurs at power up, the pump will allow the operator to access **VB_SENSE** calibration by entering "**5089**". The pump will skip directly to the **VB_SENSE** calibration step.

2.3.6.8 FINISH EDITING Alarm

The text display, **FINISH EDITING**, is displayed when additional information is required during editing before operations are resumed.

2.3.6.9 LOCK Keypress During Occlusion Alarm

The **LOCK** key will be invalid during an occlusion alarm, since **START** must be pressed to clear the alarm after the occlusion is cleared. The pump will sound a single (illegal keypress) beep if **LOCK** is pressed during an occlusion alarm.

2.3.6.10 Clear Effective Rate if Dose is Altered

In Standby state, the pump will clear the effective rate display whenever the Dose field is reset to dashes due to a syringe change or opened for editing and altered in any way. When the Dose field is closed the effective rate will be recalculated and redisplayed.

3.1 GENERAL

This chapter contains the information necessary to perform an initial inspection and set up of the pump. A functional test is included in Chapter 4 to determine if operation is satisfactory.

3.2 INITIAL INSPECTION AND DAMAGE CHECK

The pump has been thoroughly tested and inspected at the factory prior to shipment and has been found to comply to Baxter's electrical and mechanical standards. The pump has also been designed to reliably withstand normal shipment and usage conditions. However, abusive handling during shipment may cause either visible or hidden damage. Follow the instructions in this section before performing operational checks.

If any damage is observed in any of the following inspections, and this damage is related to shipping, notify the carrier's agent immediately. Do not return the damaged equipment to the factory without authorization.

3.3 INSPECTIONS

1. Carefully inspect the shipping carton. Note any obvious damage caused by mishandling and record any such damage.

2. The carton should contain the following:

   - One Auto Syringe® AS50 Infusion Pump (Catalog Code # 1M8550)
   - One Operator's Manual
   - One IV Pole Clamp
   - One Charger

3. Remove the pump from the carton and the shipping bag. Place the pump on a flat surface and perform these visual inspections:

   A. Check the entire surface for chips, scratches, dents, or cracks.

   B. Check the front keypad panel for damage.

   C. Verify that the serial number matches that on the shipping carton.

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4.1 BATTERY LIFE CHECK

The pump is provided with a NiMH battery pack. The battery pack is considered acceptable when it can operate at 80% capacity or better, following a full charge. Battery capacity can be estimated as follows:

1. Using the standard battery charger, charge the battery (with the pump turned off) for at least 16 hours.

2. Remove the battery pack within 15 minutes after disconnecting the charger. See "Battery Replacement", in chapter 7.

3. The no-load voltage must be 6.5V or greater. A reading of less than 6.5V may indicate a defective cell.

4. Connect a 135 ohm, 1/2 watt (or greater) resistive load across the battery pack.

NOTE

Resistor leads or other pins mated with the battery connector sockets must not exceed 0.025 inch diameter. The recommended pin is Molex style #70021, part #16-02-0115, available from Molex, Inc. Lisle, IL 60532 (847-969-4550).

5. Continuously monitor the battery voltage and discharge time. Use of a strip-chart recorder is recommended. The battery pack is acceptable if the battery voltage is 5V or greater after 19 hours of discharge through a 135 ohm load.

4.1.1 Replacement Recommendation

In general, the service life of rechargeable batteries is based on many factors, including construction, size, usage, frequency of charging and discharging, and depth of discharge prior to recharge. To minimize the chances of experiencing a problem with rechargeable batteries, it is advisable to replace them before their service life is expended.

Baxter® advises that pump battery replacement be made part of a regularly scheduled maintenance program. Baxter® recommends that the pump's rechargeable battery be replaced every 16 months.

4.2 FIELD PERFORMANCE CHECK

4.2.1 Purpose

To provide the customer with a procedure to perform a general evaluation of the pump's safety and performance.

- This procedure may be used to comply with JCAHO recommendations for safety and performance testing.
- This procedure contains a "Calibration Review" section to verify the pump's calibration. Refer to Chapter 5 if it is determined that the pump requires calibration.
- At the completion of the Functional Tests, check the pump's time and date for accuracy. If the pump's time and/or date needs adjustment, refer to Chapter 8 as applicable.

Calibration is to be performed by authorized trained service technicians utilizing the procedure in Chapter 5.

4.2.2 Equipment

- Operator's Manual
- 60 cc syringe (BD® or Monoject®)
- 60 inch High Flow Rate Extension Set: 2N3349 or equivalent
- Distilled water - as required
- Stopwatch or Timer
- Calibrated Pressure Gauge (0 to 20 psi) (optional)
- Calibration Fixtures Kit AAS4001803 consisting of the following 7 items:
    1. Calibration Fixture CAS4001801
    2. Calibration Fixture CAS4002801
    3. Calibration Fixture CAS4003801
    4. Calibration Fixture CAS4004801
    5. Calibration Fixture CAS4005801 (small diameter, unmarked)
    6. Calibration Fixture CAS4006801 (large diameter, unmarked)
    7. Load Yoke CAS4001802
- A coin, approximately the size of a U.S. penny (one cent)

NOTE

The Load Yoke is not required to perform any of the functional tests listed in this chapter.

4.2.3 Data Recording

It is recommended that a data sheet be kept each time this procedure is run. The data sheet is located at the end of this chapter. Fill out the pump information at the top of the data sheet before beginning this procedure. Specific sections in this procedure are indicated by ***(*D*)*** in the text below. This indicates that a recording is required on the data sheet for that section. As each section is completed, transfer any data collected to the data sheet and indicate each result as **"Pass"** or **"Fail."**

To complete the Operational Checks listed in this chapter (see section 4.2.10), the pump being tested must be configured so that four of its group options match those listed below. Refer to chapter 8, as necessary, to meet these requirements.

- "mL/hr" Mode: [Y] (Enabled)
- PSI Range: [H] (High)
- RATE Range: [H] (High)
- Volume Limit: [Y] (Enabled)

4.2.4 Visual Inspection: (*D*)

1. Look for damage, sticky residue, or any other condition that could influence performance. Clean as necessary. Ensure that the barrel clamp is properly fitted to the case. Check the security of the pole clamp (if used).

2. Examine the pump for any and all visual discrepancies (including cracks, deformations, discoloration, labeling problems and other abnormalities).

3. Examine the charger plug and the charger port on the pump for signs of mechanical damage. Pins in the charger plug must be straight and intact.

4.2.5 Charging Circuit Check: (*D*)

1. Connect the AC charger to the pump through the din connector (bottom connector) and to an AC receptacle.

2. ***(*D*)*** Verify that the **"ON CHARGE"** LED is **ON**. The pump shall be connected to AC power via the charger throughout the remaining functional tests and the **"ON CHARGE"** LED must remain on during these tests.

4.2.6 Power On Self Test (POST): (*D*)

NOTE

Read this entire step before turning the pump on.

1. Switch the pump **"ON"** and verify the following events occur:

   - The pump sounds a high-low beep;
   - All segments of the LCD and the LEDs momentarily turn on;
   - The pump sounds one short beep;
   - An identifier is momentarily displayed at the bottom of the display;

NOTE

AS50 is the factory default identifier.

   - The pump prompts for a ***LIBRARY*** or ***MODE*** selection at the completion of the **POST**.

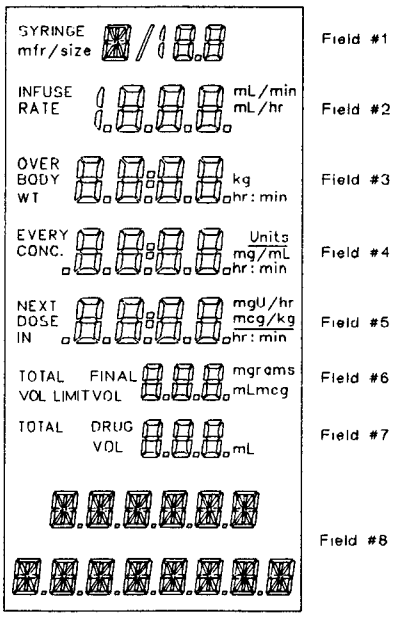
NOTE

If the pump has been configured to operate remotely, ***REMOTE CONTROL*** will appear on the display.

4.2.7 LCD and LED Check: (*D*)

1. ***(*D*)*** Switch the pump **"OFF."** Depress and hold the **STOP** key and switch the pump back **"ON."** While continuing to hold the **STOP** key depressed, observe that all nine LEDs momentarily turn **"ON"** and all but the **"ON CHARGE"** LED turn **"OFF."** Continue to hold the **STOP** key depressed and proceed to the next step.

2. ***(*D*)*** Verify that all segments of the LCD remain visible as long as the **STOP** key is depressed and that each segment appears as shown. Also confirm that there are no missing segments or legends on the LCD. Variations in contrast, however, are permissible. Release the **STOP** key. A short beep will sound when the key is released.



4.2.8 Keypad Check: (*D*)

1. *(*D*)* Press and briefly hold down the **START** and **STOP** keys one at a time. The pump should sound repeated beeps while each key is held down.

NOTE

Holding down the START key for a prolonged period of time may cause a **"stuck key"** fail-safe alarm requiring a system restart.

2. *(*D*)* Press every key, except the arrow keys, in any order, one key at a time. Each key press should result in a short beep.

3. *(*D*)* Press any two or more keys simultaneously. There should be no response.

4. *(*D*)* Press and hold any key except the arrow keys, the **START** key, or the **STOP** key. There should be only one beep, no matter how long the key is held down.

5. *(*D*)* Press and hold any key except arrow keys, **START**, or **STOP** keys. Then press any other key. There should be no response to the second key press.

4.2.9 Range of Motion Check: (*D*)

1. *(*D*)* Check the plunger driver and the barrel clamp for free travel through their full range.

2. *(*D*)* Check that the plunger seats properly and that the plunger driver does not slip on the leadscrew when the plunger is fully closed.

3. *(*D*)* Check that both barrel clamp release levers operate properly.

4. *(*D*)* Check the tab lock to be sure it opens when the barrel clamp is fully opened and closes when the barrel clamp is fully closed.

*4.2.10 Pump Operational Tests: (*D*)*

For all tests listed in this section, the **UP** (▲), **DOWN** (▼), **EDIT**, **CLR**, **CONFIRM**, and number keys may be used as necessary to program the pump and to change an existing prescription. The pump may also be turned **"OFF"** and turned back **"ON"** after each test. If the pump is accidentally switched **"OFF"** during any of these tests, switch it back **"ON"** and wait for the pump to complete the **POST** and prompt for a library selection (▲▼ ***SELECT LIBRARY*** appears on the display). Select ***NONE*** to bypass the factory configured protocol libraries. Follow the programming instruction listed for each test.

4.2.10.1 **Occlusion PSI Test:** *(*D*)*

1. Fill a B-D® or Monoject® 60 mL syringe with 60 mL of distilled water.

2. Attach a 60 inch High Flow Rate Extension Set or equivalent to the end of the syringe and manually purge the air from the syringe and tubing.

3. Install the syringe on the pump and connect the distal end of the tubing set to a calibrated pressure gauge (optional).

4. Program the pump as follows:

MODE:	mL/hr mode
MFG:	B-D® or Monoject®
SIZE:	60 mL
RATE:	100 mL/hr
VOL LIMIT:	60 mL

5. Read and understand step 6 prior to pressing the START key. Press **START**.

6. ***(*D*)*** Verify that the pump displays ***RUNNING*** at the bottom of the display for approximately 2 seconds and the run LEDs are flashing in descending order (top to bottom).

7. If a pressure gauge is not attached to the extension set, block off the end of the extension set to simulate an occlusion. If a pressure gauge is attached to the extension set, wait for an occlusion to occur.

NOTE

When the pump senses sufficient back pressure, created by the pressure gauge, an occlusion will occur.

8. ***(*D*)*** Verify that, as the pump senses the occlusion, ***LINE OCCLUDED*** is displayed, **ALERT** and **STANDBY** LEDs flash, and the pump beeps continuously.

9. Press **CONFIRM** to silence the alarm.

10. ***(*D* [optional])*** If a pressure gauge is being used, record the pressure reading in psi on the data sheet. The reading should be between 12.0 and 20.0 psi.

11. Remove the syringe from the pump. Disconnect pressure gauge if necessary.

4.2.10.2 **Near End Alarm Test: *(*D*)***

1. Install an empty B-D® or Monoject® 60 mL syringe in the pump. Set the plunger at the 60 mL mark on the syringe.

2. Program the pump as follows:

MODE:	mL/hr mode
MFG:	B-D® or Monoject®
SIZE:	60 mL
RATE:	280 mL/hr
VOL LIMIT:	50 mL

3. Read and understand step 4 prior to pressing the START key. Press **START**.

4. ***(*D*)*** Verify that the pump displays ***RUNNING*** at the bottom of the display for approximately 2 seconds and the run LEDs are flashing in descending order (top to bottom).

5. ***(*D*)*** Verify that during the infusion, the pump emits 5 beeps, the **ALERT** LED flashes and ***<10 MIN VOL LIM*** appears on the display.

6. ***(*D*)*** Allow the pump to continue infusing until the volume limit is reached. Verify ***VOLUME LIMIT*** is displayed, **ALERT** and **STANDBY** LEDs flash, and the pump beeps continuously.

7. Press **CONFIRM** to silence the alarm.

4.2.10.3 **Accuracy Test:** ***(*D*)***

1. Install an empty B-D® or Monoject® 60 mL syringe in the pump. Set the plunger at the 60 mL mark on the syringe.

2. Program the pump as follows:

MODE:	mL/hr mode
MFG:	B-D® or Monoject®
SIZE:	60 mL
RATE:	200 mL/hr
VOL LIMIT:	60 mL

3. ***(*D*)*** Record start volume from the syringe. Use the graduations on the syringe to determine the volume.

4. Set the timer for 15 minutes. Simultaneously start the timer and press the **START** key on the pump to start the infusion process.

5. During the infusion, the pump emits 5 beeps, the **ALERT** LED flashes and ***<10 MIN VOL LIM*** appears on the display.

6. ***(*D*)*** After 15 minutes, press the **STOP** key on the pump. Record the stop volume on the syringe. Subtract the stop volume from the start volume and record the result as the volume delivered. The volume delivered must be between 48.5 cc and 51.5 cc.

NOTE

It is essential that the test be stopped at precisely 15 minutes. An 18 second difference will result in a 1 mL error.

7. Switch the pump **"OFF"** and remove the syringe from the pump.

4.2.10.4 **Shutdown Alarm Test:** ***(*D*)***

1. Remove the pole clamp and the battery from the pump (refer to Chapter 7 for details). DO NOT disconnect the battery at this time.

2. Ensure that the AC charger is NOT plugged into the pump.

3. Switch the pump **"ON"** and allow the pump to remain on for a minimum of 1 minute.

4. Disconnect the battery stack from the pump.

5. ***(*D*)*** The pump will then begin to alarm, alternating from 2 high beeps to 2 low beeps. Ensure that the pump continues to alarm for a minimum of 3 minutes. There should be nothing on the display and no LEDs will be lit.

6. Switch the pump **"OFF."**

4.2.10.5 **"Fuse Failure" Alarm Test:** ***(*D*)***

1. Ensure that the pole clamp and battery are removed from the pump (refer to Chapter 7 for details). Ensure that the battery is connected to the pump.

2. Connect the AC charger to the pump and into an AC receptacle.

3. Switch the pump **"ON"** and allow the pump to complete the **POST**.

4. Disconnect the battery stack from the pump.

5. ***(*D*)*** After a short period of time (approximately a minute or so), the display will read ***FUSE FAILURE***, the **ON CHARGE, BATTERY** and **SYSTEM** LEDs will be on and the pump will alarm continuously with alternating high-low beeps.

6. Switch the pump **"OFF."**

7. Reinstall the battery, battery cover and pole clamp, as necessary (refer to Chapter 7 for details).

*4.2.11 Calibration Review: (*D*)*

NOTE

If the pump fails any part of this review, the pump must be re-calibrated (refer to Chapter 5).

4.2.11.1 **Activating the Calibration Review Mode:**

1. Switch the pump **"ON"** and wait for the pump to complete the **POST** and prompt for a selection.

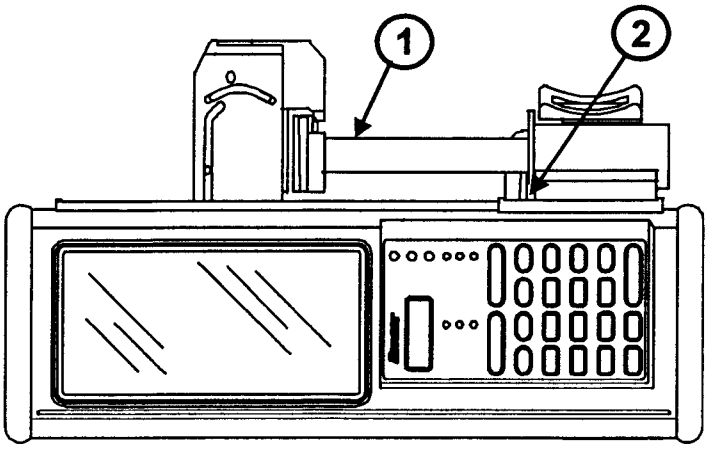
2. Enter Calibration Review access code **3 2 1**.

3. Observe that ***DRIVEPOS*** appears on the display.

4.2.11.2 **Plunger Driver Position Review: *(*D*)***

1. Install the calibration fixture (CAS4001801) (1) into the barrel clamp ensuring that the flange of the fixture fits into the flange slot (2).

2. ***(*D*)*** Push the barrel clamp in until the face contacts the fixture. Engage the plunger driver to the fixture. With the clamp fully closed, verify that the **BATTERY**, **STANDBY**, and **LOCK** LEDs are all **"ON."** This confirms that the fixture is mounted properly.



NOTE

After installing the fixture, do not touch the plunger face or the fixture.

3. ***(*D*)*** Observe the display and record the inches number value on the data sheet. Verify that this value is between 2.792 and 2.804 inches (2.792 < inches value < 2.804).

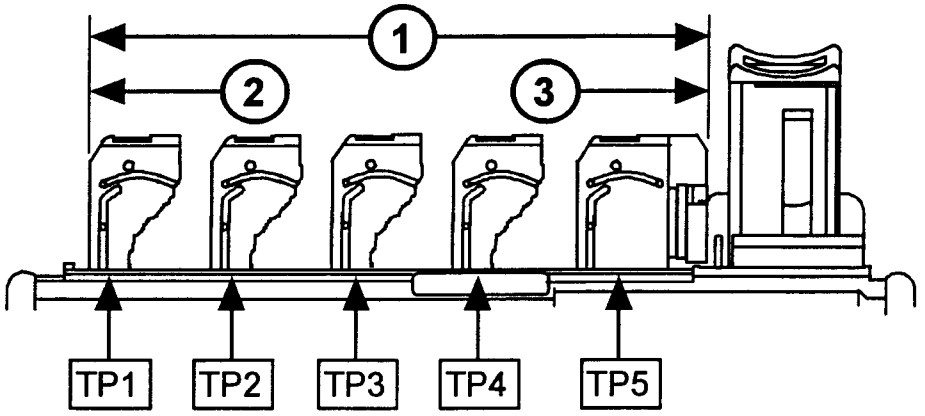
4. ***(*D*)*** Remove the fixture from the pump and install the CAS4002801 fixture into the barrel clamp. Close the clamp and engage the plunger driver to the fixture. Verify that the **BATTERY**, **STANDBY**, and **LOCK** LEDs are all **"ON."**

5. ***(*D*)*** Observe the display and record the inches number value on the data sheet. Verify that this value is between 0.666 and 0.678 inches (0.666 < inches value < 0.678).

6. Remove the fixture from the pump.

4.2.11.3 **Plunger Driver Potentiometer and Plunger Capture Checks:**

This check is performed to verify that the plunger driver position sensor operates properly throughout the entire travel range (1) of the plunger driver from start (2) to end (3) of plunger driver travel. Five approximately evenly spaced test points [(TP1 through TP5)], are to be used to perform this check.



1. ***(*D*)*** Position the plunger driver at the first test point (TP1) and insert a coin in the plunger driver. **Ensure that the plunger driver is fully closed** and confirm that the **"BATTERY"** LED turns **"ON."**

2. ***(*D*)*** Without moving the plunger driver from TP1, retract the driver until it is fully extended and remove the coin. With the driver held in its fully extended position, verify that the A/D count number (Field #3) is less than 3. Release the plunger driver and allow it to fully close. With the driver fully closed, verify that the A/D count number is again less than 3.

3. ***(*D*)*** Move the plunger to the next test point. Repeat steps 1 and 2, recording the appropriate entries to the data sheet for test points TP2 through TP5.

NOTE

DO NOT PRESS THE CONFIRM KEY.

4.2.11.4 **Tilt Switch Function Check: *(*D*)***

1. ***(*D*)*** Stand the pump upright and observe that the ALERT LED is **"ON."**

2. ***(*D*)*** Lay the pump horizontally and observe the ALERT LED turns **"OFF."**

4.2.11.5 **Barrel Clamp and Tab Sensor Checks: *(*D*)***

1. Mount a syringe onto the pump by closing the barrel clamp and capturing the syringe plunger with the plunger driver. The syringe flange should be pointed into the tab slot.

2. ***(*D*)*** Verify **STANDBY**, **LOCK** and **BATTERY** LEDs are all **"ON."**

3. Press **CONFIRM** and observe the ***SYRNGREC*** prompt appearing on the display.

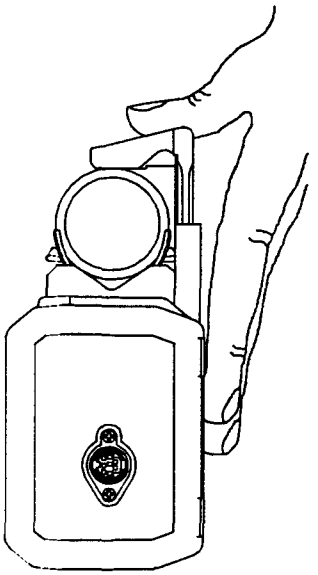
4. Remove the syringe.

4.2.11.6 **Syringe Recognition Review: *(*D*)***

1. Lay the pump down on the power switch so that the plunger driver faces upward.

2. Gently set the CAS4003801 fixture onto the barrel clamp cradle. Ensure that the fixture does not contact the tablock bracket of the barrel clamp and do not apply any pressure on the fixture.

3. Place thumb of left hand on the barrel clamp release lever and thumb of right hand on the orange "PRESS HERE" dot of the barrel clamp face. Push down on the release lever and while continuing to keep this lever held down, slowly push the barrel clamp face in towards the fixture until the clamp very lightly contacts the fixture. Do not release the lever or the face and proceed **IMMEDIATELY** to step 4.



NOTE

One hand may be used to perform this operation as shown.

4. ***(*D*)*** Smoothly and slowly apply increasing thumb pressure on the barrel clamp face (inward and slightly to the rear) and stop **IMMEDIATELY** when the LOCK LED illuminates. The Inches number (Field #4) should be between 0.732 to 0.752 inches (0.732 < inches < 0.752) at the exact point when the LOCK LED illuminates.

5. Open the barrel clamp and remove the fixture.

6. ***(*D*)*** Set the CAS4004801 fixture onto the barrel clamp cradle and repeat steps 3 and 4. The inches number should be between 0.281 to 0.301 inches (0.281 < inches < 0.301).

7. Open the barrel clamp and remove the fixture.

8. ***(*D*)*** Set the CAS4005801 fixture onto the barrel clamp cradle and repeat steps 3 and 4. The inches number should be between -0.024 to +0.026 inches (-0.024 < inches < +0.026).

NOTE

If the inches number is incorrect, the barrel clamp must be replaced.

9. Open the barrel clamp and remove the fixture.

10. ***(*D*)*** Set the CAS4006801 fixture onto the barrel clamp cradle and repeat steps 3 and 4. The inches number should be between 0.989 to 1.041 inches (0.989 < inches < 1.041).

NOTE

If the inches number is incorrect, the barrel clamp must be replaced.

11. Open the barrel clamp and remove the fixture.

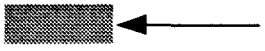
12. Press **CONFIRM** and verify that the pump displays ***PRESSENS.***

4.2.11.7 Pressure Sensor Check: *(*D*)*

1. Lay the pump down so that the front of the pump faces upward, position the plunger driver near the top of the pump, and enable the pump's motor by capturing a coin in the plunger driver.

2. ***(*D*)*** As soon as the pressure sensor force value appears on the display, view the display for 10 seconds and verify that this value remains at 0.0 ± 0.15 (-0.15 ≤ value ≤ +0.15) throughout this time period.

3. Press **CONFIRM**. Observe that, from top to bottom, the display indicates as follows:


A/D count number

Voltage (number)

VB SENSE

4. Press **CONFIRM** twice to exit the Calibration Review mode. The pump responds by repeating the power-on self test (**POST**) and prompts for a selection.

5. Switch the pump **"OFF"** and disconnect the charger.

6. Sign and date the data sheet.

4.3 AS50 FUNCTIONAL TEST DATA SHEET

Pump Serial Number _____

Indicate PASS or FAIL, as appropriate, upon completion of each operation.

Describe any failures in Comment section and seek appropriate servicing.

4.2.4	Visual Inspection			( ) P	( ) F
4.2.5	Charging Circuit, step 2			( ) P	( ) F
4.2.6	Power On Self Test (POST)			( ) P	( ) F
4.2.7	LCD and LED Check	step 1	(all nine LEDs momentarily turn ON)	( ) P	( ) F
		step 2	(all LCD segments appear as shown)	( ) P	( ) F
4.2.8	Keypad Check,	step 1	(Repeated beeps verified for START & STOP keys)	( ) P	( ) F
		step 2	(Short beep verified for all keys except arrow keys)	( ) P	( ) F
		step 3	(No response detected for simultaneously keypress)	( ) P	( ) F
		step 4	(One beep detected for all keys except arrows, START & STOP)	( ) P	( ) F
		step 5	(No response detected for second keypress)	( ) P	( ) F
4.2.9	Range of Motion,	step 1	(Plunger Driver & Barrel Clamp travel freely)	( ) P	( ) F
		step 2	(Plunger Driver seats and locks properly and does not slip)	( ) P	( ) F
		step 3	(Both barrel clamp release levers operate properly)	( ) P	( ) F
		step 4	(Tab Lock opens and closes properly)	( ) P	( ) F
4.2.10	Pump Operational Tests				
4.2.10.1	Occlusion PSI Test	step 5	(Pump displays RUNNING for approximately 2 seconds)	( ) P	( ) F
		step 7	(LINE OCCLUDED is displayed, ALERT & STANDBY LEDs flash, and pump beeps continuously)	( ) P	( ) F
		step 9	(optional) Specification = [12.0 psi < pressure reading < 20.0 psi] Pressure reading _____	( ) P	( ) F
4.2.10.2	Near End Alarm Test	step 4	(Pump displays RUNNING for approximately 2 seconds & RUN LEDs flash in descending order)	( ) P	( ) F
		step 5	(Pump displays < 10 MIN VOL LIMIT message with 5 beeps)	( ) P	( ) F
		step 6	(VOLUME LIMIT is displayed, ALERT & STANDBY LEDs flash, and pump beeps continuously)	( ) P	( ) F
4.2.10.3	Accuracy Test	step 3	(Start Volume) _____		
		step 6	(Stop Volume) _____ Specification = [48.5 cc < volume delivered < 51.5 cc] Volume delivered _____	( ) P	( ) F
4.2.10.4	Shutdown Alarm	step 5	(Pump continuously alarms for a minimum of 3 minutes)	( ) P	( ) F
4.2.10.5	Fuse Fail. Alarm	step 5	(Fuse Failure display, Battery & System LEDs, beeps)	( ) P	( ) F
4.2.11	Calibration Review Section				
4.2.11.2	Plunger Drive Position Review	step 2	(BATTERY, STANDBY, & LOCK LEDs turn on)	( ) P	( ) F
		step 3	Specification = [2.792 < inches value < 2 .804] Value observed _____	( ) P	( ) F
		step 4	(BATTERY, STANDBY, & LOCK LEDs turn on)	( ) P	( ) F
		step 5	Specification = [0.666 < inches value < 0.678] Value observed _____	( ) P	( ) F

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4.3 AS50 FUNCTIONAL TEST DATA SHEET

Pump Serial Number _____

4.2.11.3	Plunger Drive Potentiometer & Plunger Capture Checks	step 1	(BATTERY LED is ON)	( ) P	( ) F
		step 2	(A/D Count < 3 for TP1)	( ) P	( ) F
		step 3	(A/D Count < 3 for TP2)	( ) P	( ) F
		↓	(A/D Count < 3 for TP3)	( ) P	( ) F
			(A/D Count < 3 for TP4)	( ) P	( ) F
		step 3	(A/D Count < 3 for TP5)	( ) P	( ) F
4.2.11.4	Tilt Switch Function Check	step 1	(ALERT LED turns ON)	( ) P	( ) F
		step 2	(ALERT LED turns OFF)	( ) P	( ) F
4.2.11.5	Barrel Clamp & Tab Sensor Checks	step 2	(STANDBY, LOCK, & BATTERY LEDs light)	( ) P	( ) F

4.2.11.6 Syringe Recognition Review

step 4	Specification = [0.732 < inches value < 0.752]	( ) P	( ) F
	Value observed _____		
step 6	Specification = [0.281 < inches value < 0.301]		
	Value observed _____	( ) P	( ) F
step 8	Specification = [-0.024 < inches value < +0.026]		
	Value observed _____	( ) P	( ) F
step 10	Specification = [0.989 < inches value < 1.041]		
	Value observed _____	( ) P	( ) F

4.2.11.7 Pressure Sensor Check

step 2	Specification = [-0.15 ≤ value ≤ +0.15]		
	Value observed _____	( ) P	( ) F

4.2.11 Calibration Review, Check Pass or Fail after performing all tests in section 4.2.11 ..... ( ) P ( ) F

Comments: _____

_____

_____

_____

Performed By: _____ Date: _____

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5.1 GENERAL

5.1.1 Cleaning Interval

The pump should be cleaned and disinfected, if necessary, according to frequency of use and hospital protocol. See Section 5.2 for Cleaning and Disinfecting.

5.1.2 Calibration Interval

Calibration is recommended every 6 months and recalibration is also required after any procedure involving the removal of the barrel clamp, removal of the plunger driver or opening of the case halves. See Section 5.3 for the Calibration Procedure.

5.1.3 Functional Testing Interval

To ensure that the pump is operating properly, it is recommended that the pump be tested at a minimum of every 6 months per the Functional Tests outlined in Chapter 4.

5.2 CLEANING AND DISINFECTING

CAUTION

The pump and AC adapter are not waterproof and should not be immersed. Avoid getting liquids inside the pump or permanent damage may result. Sterilization via ETO, steam, etc. shall not be attempted.

5.2.1 Routine Cleaning

The pump must be kept clean at all times. The pump should be cleaned as soon as possible after each use to minimize the accumulation and hardening of spilled solutions. Dirt, sticky films, or foreign substances could cause delivery problems.

5.2.1.1 **Exterior**

All exterior surfaces are to be cleaned with a soft cloth or cotton swabs dampened with a properly diluted cleaning agent listed in Table 5-1, rinsed with a dampened cloth, then wiped dry with a soft cloth.

5.2.1.2 **Moving Parts**

The moving parts may be cleaned by wiping carefully with a soft cloth sparingly dampened with a properly diluted cleaning solution listed in Table 5-1, then wiping dry with a soft cloth. Do not spray cleaning agents directly on the pump. Any solution spillage onto the pump should be cleaned immediately.

5.2.1.3 Cleaning Agents

The exterior surfaces of the pump may be cleaned with any of the agents listed in Table 5-1 when used in accordance with manufacturer's instructions. Some caustic cleaning agents are known to degrade the integrity of the case material. Only those cleaners listed in Table 5-1 used appropriately have been tested with positive results.

TABLE 5-1

Cleaner	Manufacturer
5%-10% solution of chlorine bleach and water (1:19 to 1:9 ratio)	Commercially available
Cidex and activator	Arbrook
Manu-Klenz®	Steris Corp.
LPH SE	Steris Corp.
Vesphene® II SE	Steris Corp.
Hi-Tor®	ECO Labs
Tor®	ECO Labs
Bafix	Hysan/AM

NOTE

Do not use cleaning solutions containing n-alkyl dimethyl ethylbenzyl ammonium chloride. This compound is known to degrade plastic components over time.

5.2.1.4 General Guidelines

- The charger plug and power switch areas must be kept clean and dry at all times. Do not clean the pump while the charger is plugged in.
- Some liquids spilled into the barrel clamp area may temporarily cause excessive **CHECK SYRINGE, CHECK FLANGE OR CHECK BARREL** messages. Proper operation is generally restored after the barrel clamp dries.
- If routine cleaning does not restore proper operation, the pump should be removed from service and given a "service cleaning". This procedure is described in Section 5.2.2.
- The pump may not be sterilized by autoclave, ETO, gamma ray, or any other method that is harmful to plastic materials or electronic devices.
- Do not use spray solvents or any type of penetrating oil.

5.2.2 Service Cleaning

The pump is designed for easy cleaning. The routine cleaning procedure is described under "Routine Cleaning". The Service Cleaning procedure is more thorough than the routine cleaning procedure. Service Cleaning is recommended when conductive, corrosive, or sticky liquids are spilled on the pump. This type of contamination can cause corrosion, binding of moving parts, or frequent syringe related alarms/alert messages. Prior to cleaning the pump according to this procedure, ensure that any driver movement binding is not caused by damage to the mating surface of the lower plunger driver to the upper plunger driver.

5.2.2.1 **Barrel Clamp Cleaning**

1. Remove the barrel clamp as described in Chapter 7, section 7.2.4.1.

2. Carefully irrigate the contaminated surfaces of the barrel clamp, using a soft-bristled brush to work the solution into all corners and crevices. Open and close the clamp a few times, to help distribute the cleaning solution.

NOTE
DO NOT IMMERSE THE BARREL CLAMP ASSEMBLY.

3. If this does not loosen the dirt, wipe with a sponge and any of the approved cleaning agents (see Table 5-1), followed by a rinse with water or a dilute mixture of soap and water. Do not allow the cleaning agent or rinsing agent to leak into the barrel clamp electronics.

4. After removing all contamination, shake off excess liquid and blot the assembly dry with a clean paper towel. Air dry overnight at room temperature.

5. Replace the zebra strip with a new one and reinstall the barrel clamp as described in Chapter 7, section 7.2.4.2. Recalibration is required.

5.2.2.2 **Plunger Drive Cleaning**

(Refer to the assembly procedures in Chapter 7 for additional information.)

This procedure is to be followed only if the plunger driver cannot be cleaned with the routine cleaning procedure.

1. Inspect the drive chamber seals (black seals at both ends of the drive chamber) for dryness, cracks, or other damage. If any damage is evident, the pump must be repaired.

2. Work the plunger driver and drive assembly while irrigating with one of the cleaners listed in Table 5-1. DO NOT IMMERSE THE PUMP!

3. Extend the plunger clamp and direct a low-velocity stream of warm water from a water bottle onto the driver assembly. Direct the stream carefully, to minimize the amount of water that enters the drive compartment.

4. Remove the upper plunger driver (see Chapter 7 for details).

5. Surface contamination can be cleaned by wiping with a sponge or cotton swab and any of the Baxter® approved cleaning agents. Do not allow cleaning agents to flow into the drive compartment.

6. If the drive compartment is contaminated, flush the drive area with warm water. Hold the pump in a horizontal position, so that water runs out the side of the drive area, and not the ends.

7. Dry the plunger and drive assembly by blotting, followed by a gentle air stream or letting the unit stand unused overnight.

8. Reinstall the upper plunger driver (see Chapter 7 for details). Recalibration is required.

5.2.2.3 **Return to Service**

The pump must successfully complete the Functional Tests described in Chapter 4 before being returned to service. If there is a problem, the pump must be repaired, recalibrated, and retested.

NOTE

Because the above procedure requires skill and careful attention to detail, the manufacturer cannot assume responsibility for damage caused by ingress of cleaning agents or other fluids into sensitive areas of the pump.

5.3 CALIBRATION PROCEDURE

5.3.1 Calibration Overview

The pump includes two calibration modes which allow the biomedical/service technician to either set or review calibration settings for several pump sensors. Entering access code **5 0 8 9** initiates the "Calibration Set" mode (covered in this chapter) and permits specific pump sensor settings to be compared against and set according to acceptable calibration standards. To check but not alter any previous pump settings, a "Calibration Review" mode (refer to chapter 4) is also provided and may be selected by entering access code **3 2 1**.

5.3.2 Equipment Needed

- Calibration Fixtures Kit AAS4001803 consisting of the following 7 items:
    1. Calibration Fixture CAS4001801
    2. Calibration Fixture CAS4002801
    3. Calibration Fixture CAS4003801
    4. Calibration Fixture CAS4004801
    5. Calibration Fixture CAS4005801 (small diameter, unmarked)
    6. Calibration Fixture CAS4006801 (large diameter, unmarked)
    7. Load Yoke CAS4001802
- IV Pole or equivalent
- 10 lb weight with chain or 100 lb.-test monofilament line
- Variable DC Power Supply
- Multimeter with minimum 5 1/2 digit capability
- Phillips® screwdriver
- Torque screwdriver

5.3.3 Data Recording

It is recommended that a data sheet be kept each time this procedure is run. The data sheet is located at the end of this chapter. Fill out the pump information at the top of the data sheet before beginning this procedure. Specific sections in this procedure are indicated by ***(*D*)*** in the text below. This indicates that a recording is required on the data sheet for that section. As each section is completed, transfer any data collected to the data sheet and indicate each result as **"Pass"** or **"Fail."**

5.3.4 General Information

1. Read the entire procedure before beginning calibration.

2. When in doubt throughout any portion of the calibration that either the steps exercised might be in error or that the actual results are not matching expected results, shut the pump off and start over. Also, if the pump is accidentally switched **"OFF"** during calibration, the calibration sequence being performed must be repeated.

3. It is possible to skip over portions of the calibration by using the **UP** (▲) or **DOWN** (▼) keypad keys to toggle the **"Y"** to **"N"** when queried with either **"CAL DRIVEPOS," "CAL SYRNGREC," "CAL PRESSENS"** or **"CAL VB-SENSE."**

4. To avoid accidental alteration of calibration settings, do not press **CONFIRM** unless instructed to do so.

5. At the end of each calibration sequence, the pump will momentarily display an ***UPDATING*** message as the new calibration information is being saved. During or prior to these periods, adhere to the following guidelines:

   - DO NOT switch the pump **"OFF"** while the ***UPDATING*** message is being displayed. Doing so will cause any new information recorded by the pump, during calibration, to become lost or corrupted. New settings are not saved until the ***UPDATING*** message has disappeared from the display.
   - DO NOT press any key during this ***UPDATING*** period.
   - DO switch the pump **"OFF"** prior to the ***UPDATING*** message appearing on the display if it is desired to abort the sequence and leave the original settings unchanged.

6. The LEDs that are **"ON"** at the beginning and end of each sensor calibration sequence (before and after the portion of the sequence in which the standards are read) are as follows:

   - The **ALERT** LED is on when the pump is vertical.
   - The **BATTERY** LED is on when the plunger capture detector is detecting a syringe plunger.
   - The **STANDBY** LED is on when the flange sensor is detecting a syringe flange.
   - The **LOCK** LED is on when the barrel sensor is detecting a syringe barrel.

5.3.5 Calibration Procedure

5.3.5.1 **Calibration Set-up**

1. Plug the charger into a 115 VAC power source and connect the output connector of the charger to the pump's charger port.

2. Switch the pump **"ON"** and allow the pump to go through its power-on self-test (POST).

5.3.5.2 **Activating Calibration Set Mode**

NOTE

The pump sounds an error beep for each key pressed. These tones are provided to discourage unauthorized access and may be ignored.

1. Enter access code **5089**. The pump responds and ***DRIVEPOS*** appears on the display. Disregard the numbers in the upper part of the display.

2. Press **CONFIRM**.

5.3.5.3 **Plunger Driver Position Calibration Procedure**

1. Observe the prompts, ***N*** and ***CAL DRIVEPOS***, on the display.

2. Press the ▲ or ▼ key to change the flashing ***N*** to ***Y***. Do not select ***N*** as this will cause the pump to skip the Plunger Driver Position calibration sequence and continue on to the Syringe Recognition Detection calibration sequence.

3. Press **CONFIRM**.

4. Calibrating the 2.798 Point

4.1 Observe the prompt, ***VERIFY 2.798***, on the display.

4.2 Install the calibration fixture (CAS4001801) into the barrel clamp ensuring that the flange of the fixture fits into the flange slot.

4.3 Push the barrel clamp in until the face contacts the fixture. Engage the plunger driver onto the fixture.

NOTE

After installing the fixture, do not touch the plunger face or the fixture.

4.4 Press **CONFIRM** to lock in the 2.798 measurement.

5. Calibrating the 0.672 Point

5.1 Observe the prompt, ***VERIFY 0.672***, on the display.

5.2 Remove the fixture from the barrel clamp.

5.3 Install the calibration fixture (CAS4002801) into the barrel clamp and engage the plunger driver to the fixture.

NOTE

After installing the fixture, do not touch the plunger face or the fixture.

5.4 Press **CONFIRM** to lock in the 0.672 setting. Observe the ***DRIVEPOS*** prompt appearing at the bottom of the display and the two number values above it. LCD Field #3 displays an A/D number value and LCD Field #4 displays the value in inches representing the distance from the syringe flange to the face of the plunger driver. During steps 7 and 9 of this section, the latter value shall be verified using fixtures CAS4001801 and CAS4002801.

6. Remove fixture CAS4002801 from the barrel clamp and reinstall it onto the barrel clamp. Close the clamp and engage the plunger driver to the fixture. Observe that the **BATTERY**, **STANDBY**, and **LOCK** LEDs are all **"ON."** This confirms that the fixture is mounted properly.

7. ***(*D*)*** Observe the display and record the inches number value on the data sheet. Verify that this value is between 0.666 and 0.678 inches (0.666 < inches value < 0.678). Indicate **"Pass"** or **"Fail"** on the data sheet.

8. Remove the fixture from the pump and reinstall the CAS4001801 fixture into the barrel clamp. Close the clamp and engage the plunger driver to the fixture. Confirm that **BATTERY**, **STANDBY**, and **LOCK** LEDs are all **"ON."**

9. ***(*D*)*** Observe the display and record the inches number value on the data sheet. Verify that this value is between 2.792 and 2.804 inches (2.792 < inches value < 2.804). Indicate **"Pass"** or **"Fail"** on the data sheet.

10. If the readings observed and recorded in steps 7 and 9 are both within specification, proceed to step 11. If either reading or both readings are not within specification, switch the pump **"OFF"** and **"ON"** and wait for the pump to prompt for a selection. Then repeat calibration beginning at section 5.3.5.2.

11. Press **CONFIRM.** The pump responds and momentarily displays an ***UPDATING*** message while the new calibration information is being saved. When this message disappears, the new plunger driver calibration settings become stored and a new message, ***SYRNGREC***, appears on the display.

CAUTION

To prevent corruption of the calibration data, do not turn off the pump while UPDATING is being displayed.

5.3.5.4 Syringe Recognition Detection Calibration Procedure

NOTE

The syringe support system is relatively compliant and the measurement system is very sensitive. A certain amount of practice may be required to obtain consistent results.

1. Press **CONFIRM** and observe that ***CAL SYRNGREC*** appears on the display.

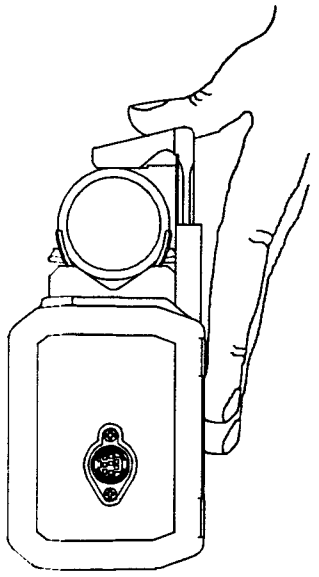
2. Press the ▲ or ▼ key to select ***Y*** and press **CONFIRM.** Do not select ***N*** as this will cause the pump to skip the Syringe Recognition Detection Calibration sequence.

3. Observe that ***CLAMP 0.742 IN*** appears on the display. For now, disregard the A/D count number appearing in Field 3 of the display.

4. Lay the pump down on the power switch so that the plunger driver faces upward.

5. Gently set the CAS4003801 fixture onto the barrel clamp cradle. Ensure that the fixture does not contact the tablock bracket of the barrel clamp and do not apply any pressure on the fixture.

6. Place thumb of left hand on the barrel clamp release lever and thumb of right hand on the orange "PRESS HERE" dot of the barrel clamp face. Push down on the release lever and while continuing to keep this lever held down, slowly push the barrel clamp face in towards the fixture until the clamp very lightly contacts the fixture. Do not release the lever or the face and proceed **IMMEDIATELY** to step 7.



NOTE

One hand may be used to perform this operation as shown.

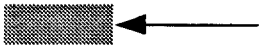
7. Smoothly and slowly apply increasing thumb pressure on the barrel clamp face (inward and slightly to the rear) and stop **IMMEDIATELY** once the pump beeps.

8. Observe that ***CLAMP 0.291*** appears on the display. Disregard the A/D count number appearing in Field 3 of the display.

9. Open the barrel clamp and remove the fixture.

10. Set the CAS4004801 fixture onto the barrel clamp cradle and repeat steps 6 and 7.

11. Observe that, from top to bottom, the display now indicates the following:

     A/D count number

    Inches number

    SYRNGREC

NOTE

DO NOT PRESS **CONFIRM**.

12. Remove the fixture from the pump and reinstall the CAS4003801 fixture.

13. ***(*D*)*** Verify the barrel clamp calibration by repeating steps 6 and 7, except instead of listening for the "beep," stop **IMMEDIATELY** when the LOCK LED illuminates and record the inches number being displayed as the "1st Reading" on the data sheet. Verify that the inches number is between 0.7367 to 0.7467 inches (0.7367 < inches value < 0.7467).

    - ***(*D*)*** If the inches number is within specification, check **"Pass"** and record N/A next to "2nd Reading" on the data sheet. Proceed to step 14.

    - ***(*D*)*** If the inches number is not within specification, restart calibration from step 5.3.5.4 and record the "2nd Reading" inches value and **"Pass"** or **"Fail"** on the data sheet.

NOTE

DO NOT PRESS **CONFIRM**.

14. Remove the fixture from the pump and install the CAS4004801 fixture.

15. ***(*D*)*** Repeat the process detailed in step 13 and record the inches number on the data sheet. Verify that the inches number is between 0.2859 to 0.2959 inches (0.2859 < inches value < 0.2959).

    - ***(*D*)*** If the inches number is within specification, check **"Pass"** and record N/A next to "2nd Reading" on the data sheet. Proceed to step 16.

- ***(*D*)*** If the inches number is not within specification, restart calibration from step 5.3.5.4 and record the "2nd Reading" inches value and **"Pass"** or **"Fail"** on the data sheet.

16. Remove the fixture from the pump and install the CAS4005801 fixture.

17. ***(*D*)*** Repeat the process detailed in step 13 and record the inches number on the data sheet. Verify that the inches number is between -0.03 to +0.02 inches (-0.03 < inches value < +0.02).

    - ***(*D*)*** If the inches number is within specification, check **"Pass"** and record N/A next to "2nd Reading" on the data sheet. Proceed to step 18.

    - ***(*D*)*** If the inches number is not within specification, replace the barrel clamp, restart calibration from step 5.3.5.4 and record the "2nd Reading" inches value and **"Pass"** or **"Fail"** on the data sheet.

18. Remove the fixture from the pump and install the CAS4006801 fixture.

19. ***(*D*)*** Repeat the process detailed in step 13 and record the inches number on the data sheet. Verify that the inches number is between 0.995 to 1.035 inches (0.995 < inches value < 1.035).

    - ***(*D*)*** If the inches number is within specification, check **"Pass"** and record N/A next to "2nd Reading" on the data sheet. Proceed to step 20.

    - ***(*D*)*** If the inches number is not within specification, replace the barrel clamp, restart calibration from step 5.3.5.4 and record the "2nd Reading" inches value and **"Pass"** or **"Fail"** on the data sheet.

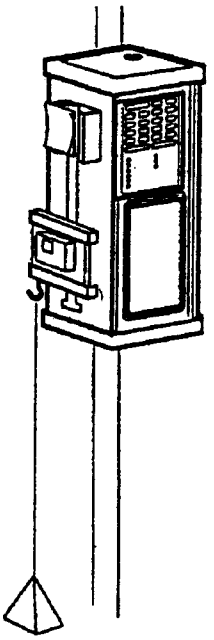
20. Remove the fixture from the pump.

21. Press **CONFIRM.** An ***UPDATING*** message appears on the display for a few seconds while the new calibration information is being saved. When this message disappears, the new syringe recognition calibration settings become stored and a new message, ***PRESSENS***, appears on the display.

CAUTION

To prevent corruption of the calibration data, do not turn off the pump while UPDATING is being displayed.

5.3.5.5 **Pressure Sensor Calibration Procedure**



1. Move the plunger driver to approximately 1/3 the distance from the bottom end of its travel (barrel clamp end).

2. Ensure that the pole clamp is on the pump and mount the pump upside down on the IV pole.

3. Press **CONFIRM** and observe that ***CAL PRESSENS*** appears on the display.

4. Press the ▲ or ▼ key to select ***Y.*** Do not select ***N*** as this will cause the pump to skip the Pressure Sensor Calibration sequence.

5. Ensure that the plunger driver is still at 1/3 distance from the barrel clamp and install the load yoke (CAS4001802) in the plunger driver.

6. Attach the chain or monofilament line to the hook on the load yoke. Ensure that the plunger driver is pushed in towards the pump and the load yoke is fully captured by the driver. Gently attach the 10 lb. load to the bottom of the chain or monofilament line.

7. Ensure that the weight is not spinning or swinging before proceeding to the next step.

8. Press **CONFIRM** and observe that the prompt, ***VERIFY 10.00 LB*** appears on the display.

9. Calibrate Gain (10.00 lbs)

9.1 Press **CONFIRM** and observe the ***10.00 LB*** prompt at the bottom of the display as the motor begins to run. Approximately 5 seconds later, the pump displays the A/D reading which remains displayed as the motor continues running for approximately another 10 - 15 seconds. When the motor stops, ***VERIFY 0.00 LB*** appears at the bottom of the display.

9.2 Remove the 10 Lb. load but leave the load yoke in the plunger driver.

NOTE

During the remainder of the PRESSENS calibration sequence, the pump's motor will activate and make two more sequential runs when **CONFIRM** is pressed. The 1st run will last approximately 15 - 20 seconds and the 2nd run will start immediately after the 1st run has completed. During the 1st run, A ZERO LB A/D number will appear on the display and then disappear once that run has completed. Because

of this time constraint, this number must be observed and recorded prior to commencement of the 2nd run.

10. Calibrate Zero (0.000 lbs) - 1st Run

10.1. ***(*D*)*** Press **CONFIRM** and observe the ***0.00 LB*** prompt at the bottom of the display as the motor begins its **1st run**. Approximately 5 seconds later, the pump displays the ZERO LBS A/D reading which remains displayed as the motor continues running for approximately another 10 - 15 seconds. Record the ZERO LBS A/D number and verify that this number is between 145 to 175 (145 < A/D number < 175). Record **"Pass"** or **"Fail"** on the data sheet.

11. Pressure Sense Calibration Check - 2nd Run

11.1 When the motor stops, the ***PRESSENS*** prompt appears at the bottom of the display and the pump immediately starts a **2nd run**. Approximately 5 seconds later, the pump displays the processed force measurement (in pounds) in Field #4.

11.2 ***(*D*)*** Continue watching the display for approximately 10 seconds and verify that the (zero pounds) number remains at 0.0 ± 0.15 (-0.15 ≤ value ≤ +0.15) throughout this time period. Record **"Pass"** or **"Fail"** on the data sheet.

11.3 If the readings observed and recorded in steps 10.1 and 11.2 are both within specification, proceed **IMMEDIATELY** to step 12. If either reading or both readings are not within specification, proceed as follows:

- Switch the pump **"OFF"** and **"ON."**
- When the pump to prompts for a selection, enter access code **5 0 8 9**.
- Press **CONFIRM** four times and repeat Pressure Sensor calibration beginning at 5.3.5.5, step 3.

12. Press **CONFIRM** to prevent the load yoke from contacting the base of the barrel clamp. The pump responds and an ***UPDATING*** message appears on the display for a few seconds while the new calibration information is being saved. When this message disappears, the new pressure sense calibration settings become stored and a new message, ***VB SENSE***, appears on the display.

CAUTION

To prevent corruption of the calibration data, do not turn off the pump while UPDATING is being displayed.

13. Switch the pump **"OFF"** and remove the load yoke from the pump.

14. Remove the pump from the IV pole and remove the pole clamp from the pump.

15. Disconnect the charger from the pump.

5.3.5.6 **VB SENSE Set-up Procedure**

CAUTION

To eliminate the possibility of causing any damage to the pump, the voltage output from the variable DC power supply must not be adjusted to exceed +7.505 volts at any time during this procedure.

1. Ensure that the variable DC power supply is switched **"OFF."**

2. Turn **"ON"** and set the meter to a range appropriate for measuring 20 VDC.

3. Connect the meter to the variable DC power supply.

4. Switch **"ON"** and adjust the output of the variable DC power supply to indicate 7.500 ± 0.005 volts on the meter. Once the adjustment is made, switch **"OFF"** the supply.

NOTE

Do not use the output voltmeter on the variable DC power supply (if the supply has one) to make this or any remaining measurement in this procedure.

5. Connect the variable DC power supply to the pump as follows:

5.1 Remove the three black screws holding the battery cover to the case and remove the battery cover from the case.

5.2 Turn the pump over to allow the Battery Stack Assembly to release from the battery compartment being careful not to allow the stack to fall from the case or stress the harness.

5.3 Disconnect the battery stack connector from the pump's battery connector.

5.4 Connect the variable DC power supply to the pump's battery connector.

6. Switch **"ON"** the variable DC power supply.

5.3.5.7 **VB SENSE Calibration Procedure**

1. Switch **"ON"** the pump. As soon as the pump completes the **POST** and prompts for a selection, enter access code **5089.**

2. Press **CONFIRM** seven times, pausing slightly between each key press.

3. Observe that ***CAL VB SENSE*** appears on the display.

4. Press the ▲ or ▼ arrow key to select ***Y*** and press **CONFIRM.**

5. Ensure the meter reads 7.500 ± 0.005 volts.

6. Verify that the LCD displays ***VERIFY 7.50 V.***

7. Press **CONFIRM.**

8. Reduce the output of the variable DC power supply until the meter indicates 5.500 ± 0.005 volts.

9. Verify that the LCD displays ***VERIFY 5.50 V.***

10. Press **CONFIRM** and observe the ***VB SENSE*** prompt at the bottom of the display. Disregard the two numbers appearing in the upper part of the display.

11. Increase the output of the supply until the meter indicates 6.100 ± 0.005 volts.

12. ***(*D*)*** Verify that the pump displays a voltage of 6.100 ± 0.010 volts. Record voltage and indicate **"Pass"** or **"Fail"** on the data sheet.

13. Increase the output of the supply until the meter indicates 7.500 ± 0.005 volts.

14. ***(*D*)*** Verify that the pump displays a voltage of 7.500 ± 0.010 volts. Record voltage and indicate **"Pass"** or **"Fail"** on the data sheet.

15. Reduce the output of the supply until the meter indicates 5.500 ± 0.005 volts.

16. ***(*D*)*** Verify that the pump displays a voltage of 5.500 ± 0.010 volts. Record voltage and indicate **"Pass"** or **"Fail"** on the data sheet.

17. Increase the output of the supply until the meter indicates 7.0 ± 0.5 volts.

18. Press **CONFIRM.** The pump responds and updates the data (***UPDATING*** momentarily appears on the display), repeats the power-on self test (**POST**), and prompts for a selection.

CAUTION

To prevent corruption of the calibration data, do not turn off the pump while UPDATING is being displayed.

19. ***(*D*)*** If the pump has **"passed"** all calibration requirements, check **"Pass"** in the "Calibration Confirmation" section of the data sheet and switch both the pump and variable DC power supply to their **"OFF"** positions. If recalibration is required, check **"Fail"** on the data sheet. Then reconnect the battery, enter access code **5089**, toggle to the desired calibration sequence, and recalibrate as previously specified.

20. Disconnect the power supply from the pump.

21. Reconnect the battery stack connector to the wiring harness ensuring that the tab is well seated. Place the battery stack into the battery compartment and ensure that all leads are properly dressed and are not crushed or kinked.

22. Carefully slide the cover onto the case. Use slight thumb pressure to ensure that the cover seats properly.

23. Secure the cover to the case using the three 2-32 x 3/16″ pan head screws being careful not to overtighten them.

24. Sign and date the data sheet.

5.4 AS50 CALIBRATION DATA SHEET

Pump Serial Number: _____

PLUNGER DRIVER POSITION CALIBRATION				
Proc. Step	**Specification**	**Inches**	**Pass**	**Fail**
5.3.5.3 (7)	0.666 < inches < 0.678			
5.3.5.3 (9)	2.792 < inches < 2.804			

SYRINGE RECOGNITION DETECTION CALIBRATION				
Proc. Step	**Specification**	**Inches**	**Pass**	**Fail**
5.3.5.4 (13)	0.7367 < Inches < 0.7467	1st Reading _____ 2nd Reading		
5.3.5.4 (15)	0.2859 < Inches < 0.2959	1st Reading _____ 2nd Reading		
5.3.5.4 (17)	-0.03 < Inches < +0.02	1st Reading _____ 2nd Reading		
5.3.5.4 (19)	0.995 < Inches < 1.035	1st Reading _____ 2nd Reading		

PRESSURE SENSOR CALIBRATION				
Proc. Step	**Specification**	**A/D Number**	**Pass**	**Fail**
5.3.5.5 (10.1)	145 < A/D Number < 175			
5.3.5.5 (11.2)	-0.15 ≤ value ≤ +0.15			

VB SENSE CALIBRATION				
Proc. Step	**Specification**	**Voltage**	**Pass**	**Fail**
5.3.5.7 (12)	6.090 ≤ Voltage ≤ 6.110			
5.3.5.7 (14)	7.490 ≤ Voltage ≤ 7.510			
5.3.5.7 (16)	5.490 ≤ Voltage ≤ 5.510			

Proc. Step	**CALIBRATION CONFIRMATION**	**Pass**	**Fail**
5.3.5.7 (18)	Pump passes all Calibrations.		

Performed by: _____ Date: _____

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6.1 GENERAL

Pumps under warranty must be returned to Baxter® for troubleshooting and repair. Unauthorized disassembly/repair will void your warranty. When the pump is malfunctioning, refer to the troubleshooting information in Table 6-1.

WARNING

There are no user-repairable parts or sub-assemblies. Service must be performed by a trained biomedical engineering technician.

6.2 TROUBLESHOOTING

Table 6-1 contains troubleshooting tips. Note that repair to the pump may only consist of the replacement of the parts or sub-assemblies listed in Appendix C. Refer to Chapter 7 for disassembly/assembly procedures and Appendix C for part information.

6.2.1 Tools and Equipment

- Large Phillips® screwdriver
- Small Phillips® screwdriver
- 5/64" Allen wrench
- Needle nose pliers
- 1/16" punch (or equivalent)
- Tweezers
- 89 ±0.1% ohm, 1 watt resistor

6.2.2 Troubleshooting Tips

TABLE 6-1

Symptom	Possible Cause	Solution
Constant **CHECK SYRINGE** alarm (This message indicates two or more mounting points (flange, barrel, plunger) are not correctly positioned.)	Improperly loaded syringe	Reload syringe.
	Pump out of calibration	Check calibration and re-calibrate, if necessary.
	Contaminated barrel clamp	Perform service cleaning (see Chapter 5).
	Malfunctioning barrel clamp and/or barrel clamp zebra strip	Replace barrel clamp and/or barrel clamp zebra strip and recalibrate.
	Worn, frayed or damaged barrel clamp zebra strip	Replace barrel clamp zebra strip and recalibrate.
Syringe recognition will not calibrate	Contaminated barrel clamp	Perform service cleaning (see Chapter 5).
	Malfunctioning barrel clamp and/or barrel clamp zebra strip	Replace barrel clamp and/or barrel clamp zebra strip and recalibrate.
	Worn, frayed or damaged barrel clamp zebra strip	Replace barrel clamp zebra strip and recalibrate.
Intermittent **EMPTY** alarm	Pump out of calibration	Check calibration and re-calibrate, if necessary.
Intermittent **BATTERY LOW** alarm	Battery may require charging	Recharge unit for a minimum of 16 hours and verify battery operation.
	Loose battery connection	Open battery compartment and check battery connection.

TABLE 6-1

Symptom	Possible Cause	Solution
	Loose charger connection	Wiggle the charger connector while plugged into unit and observe the charge LED. Charger and/or I/O board may need replacement.
	Damaged pins in charger connector	Ensure that charger connector pins are seated properly. If necessary, replace I/O board.
Part or all of keypad is inoperable	Malfunctioning keypad	Perform Functional Test in Chapter 4. If pump fails, replace keypad assembly.
Premature **ATTACH CHARGER** alert or premature **BAD BATTERY** alarm	Low battery	Run Battery Life Check in Chapter 4. Replace battery or recharge unit for a minimum of 16 hours and verify battery operation.
	Damaged charger or charger connector	Replace charger or I/O board.
	Battery worn out	Replace battery (battery should be replaced every 16 months).
Incorrect syringe size is recognized or **SIZE MISMATCH** errors	Improperly loaded syringe	Reload syringe.
	Wrong syringe manufacturer	Verify correct manufacturer has been programmed.
	Pump out of calibration	Check calibration and re-calibrate, if necessary.
	Contaminated barrel clamp	Perform service cleaning (see Chapter 5).
	Malfunctioning barrel clamp and/or barrel clamp zebra strip	Replace barrel clamp and/or barrel clamp zebra strip and recalibrate.

TABLE 6-1

Symptom	Possible Cause	Solution
	Worn, frayed or damaged barrel clamp zebra strip	Replace barrel clamp zebra strip and recalibrate.
Pump displays erroneous characters on LCD	Malfunctioning LCD	Perform Auxiliary LCD Test described in this chapter. If necessary, replace Digital PCB/LCD assembly.
FUSE FAILURE message	Missing or unplugged battery	Check for presence of battery and ensure proper battery connection.
	Low or bad battery	Run Battery Life Check in Chapter 4. Replace battery or recharge unit for a minimum of 16 hours and verify battery operation.
	Fuse (F2) blown	Replace I/O board.
	Battery worn out	Replace battery (battery should be replaced every 16 months).
No **ON CHARGE** light while connected to powered charger	Missing or unplugged battery	Check for presence of battery and ensure proper battery connection.
	Damaged charger or charger connector	Replace charger or I/O board.
	Fuse (F2) blown	Replace I/O board.
	Battery worn out	Replace battery (battery should be replaced every 16 months).
Error codes L000015 through L000023	Malfunctioning strain gauge PCB	Replace case/mechanical drive assembly.
Error code L000025	Motor connect P3 not plugged in or plugged in backwards	Ensure proper connection of P3 motor connector.
	Broken motor wire	Replace case/mechanical drive assembly.

TABLE 6-1

Symptom	Possible Cause	Solution
	Excess drag in mechanical drive assembly	Replace case/mechanical drive assembly.
	Malfunctioning analog PCB	Replace analog PCB.
Error code M005005	START key held down too long	Operator error.
	Stuck START key	Replace keypad assembly.
Error code M035000 or M035005	J4 not plugged in properly	Ensure proper connection of J4.
	Malfunctioning or damaged J4 connector	Replace digital PCB.
	Malfunctioning strain gauge PCB	Replace case/mechanical drive assembly.
Error code M046035	Excess drag in mechanical drive assembly	Replace case/mechanical drive assembly.
Error code M046120	Operator moved plunger driver while pump was infusing	Operator error.
	Plunger driver moved too quickly	Operator error.
	Bent softpot bracket; Bad softpot; Wiper spring out of tolerance; Broken halfnut components	Replace case/mechanical drive assembly.
Error code M046125	Malfunctioning drive assembly	Replace case/mechanical drive assembly.

NOTE

LXXXXXX codes are issued by the Slave CPU.
MXXXXXX codes are issued by the Master CPU.

6.3 AUXILIARY LCD TEST

The pump allows a detailed test of the LCD for segment shorts and opens (see Chapter 4 for a detailed illustration of the LCD segments).

1. Switch the pump **"ON"** and wait for the pump to complete the power-on self test **(POST)**.

2. Enter the Calibration Review access code **3 2 1**.

3. Observe that **DRIVEPOS** appears on the display. Press **CONFIRM** repeatedly, until **TEST LCD** appears on the display.

4. Press ▲ or ▼ to change the ***N*** to ***Y*** and press **CONFIRM**. Do not press **CONFIRM** while ***N*** is displayed as this will cause the pump to exit the calibration review mode and restart the **POST**.

5. The LCD is initially blanked. Each segment in the top line of the LCD is then turned on for 1/4 second, starting with the SYRINGE mfr/size enunciator on line 1, and proceeding from left to right through each segment to the last segment on the line.

6. When the last segment has been displayed, the test repeats with the first segment of the same line. To proceed to the next line, press **CONFIRM** at any time. Each time CONFIRM is pressed, testing begins on the next line, rolling over from the bottom line to the top line.

7. If a segment fails to turn on, or two or more of the segments turn on simultaneously, then the test has failed and the Digital/LCD PCB needs replacement.

8. Press **STOP** to terminate the LCD Test. The pump responds by repeating the power-on self test **(POST)** and prompts for a selection.

9. Switch **"OFF"** the pump.

6.4 SYSTEM ERROR CODES

Below is a listing of error codes that the pump can generate. Refer to troubleshooting Table 6-1 for corrective action(s) as applicable. This list is provided for reference purposes only.

Master Processor

Error	Description
M001000	alarm_tsk: Invalid message length
M001005	alarm_tsk: Invalid parameter
M001010	alarm_tsk: Task failed to wake up
M002000	aud_itf: Attempt to send msg to self
M002005	aud_itf: Message failed to send
M002010	aud_itf: No response to message
M002015	aud_itf: Response length invalid
M002020	aud_itf: Response type invalid
M002025	aud_itf: Response from wrong task
M002030	aud_on: Invalid argument
M002035	aud_on: Invalid cycles
M002040	aud_on: Invalid duration
M003000	res_send: Message failed to send
M003005	aud_tsk: Invalid state
M003010	aud_tsk: Message length invalid
M003015	aud_tsk: Message not for this task
M003020	aud_tsk: Message not from app_tsk or alarm_tsk
M003025	aud_tsk: Too many messages
M003030	aud_tsk: Invalid message type
M003035	aud_tsk: Audio task failed to wake up

Error	Description
M004000	malloc size too large
M004005	malloc returned NULL ptr
M005000	res_send: Message failed to send
M005005	kbd_tsk: Too many start keys
M005010	kbd_tsk: Message length invalid
M005015	kbd_tsk: Message not for this task
M005020	kbd_tsk: Message not from kbd_tsk or tmr_tsk
M005025	kbd_tsk: Message type invalid
M005030	kbd_tsk: Keyboard task failed to wake up
M005035	kbd_tsk: invalid internal state
M006000	msg_send_res_wait: Attempt to send msg to self
M006005	msg_send_res_wait: Message failed to send
M006010	msg_send_res_wait: No response received
M006015	msg_send_res_wait: Msg response length invalid
M006020	msg_send_res_wait: Msg response type invalid
M006025	msg_send_res_wait: Msg response from wrong task
M006030	tmr_create: Timer pointer not equal to zero
M006035	tmr_create: Auto reload parameter invalid value
M006040	tmr_start: Start pointer equal to zero
M006045	tmr_start: Start seconds arg invalid

Master Processor

Error	Description
M006050	tmr_start: Start seconds arg evaluates to 0
M006055	tmr_read: Read pointer NULL
M006060	tmr_stop: Stop pointer NULL
M006065	tmr_kill: Kill pointer NULL
M007000	res_send: Message failed to send
M007005	tmr_tsk: Message length invalid
M007010	tmr_tsk: Message not for this task
M007015	tmr_tsk: Message from this task
M007020	tmr_tsk: No more timers available
M007025	tmr_tsk: Duplicate tmr control block
M007030	tmr_tsk: Kill pointer NULL
M007035	tmr_tsk: Kill timer not defined
M007040	tmr_tsk: Message type invalid
M007045	tmr_tsk: Timer task failed to wake up
M008000	eep_get_raw: destination NULL
M009000	i2c_srv: attempt to capture invalid i2c channel
M009005	i2c_srv: Channel 1 failure
M009010	i2c_srv: Channel 2 failure
M009015	i2c_srv: Channel 3 failure
M009020	i2c_srv: attempt to release invalid i2c channel
M010000	dsp_data_anunc: loc_data_ndx bad
M010005	dsp_data_anunc: loc_data argument invalid
M010010	dsp_data_anunc: blink argument invalid
M010015	dsp_data_anunc_clr: data_ndx arg invalid
M010020	dsp_ascii_line_1/2: line too long
M010025	dsp_fill_all: status arg invalid
M010030	dsp_led_set: led arg invalid
M010035	dsp_led_set: color arg invalid
M010040	dsp_led_set: blink arg invalid
M011000	tx_tsk: message size invalid
M011005	ack_rcv_tsk: bb_put_message_nb failure
M012000	msg_send_res_wait: Attempt to send msg to self
M012005	msg_send_res_wait: Message failed to send
M012010	msg_send_res_wait: Message no response
M012015	msg_send_res_wait: Message response length invalid
M012020	msg_send_res_wait: Message response type invalid
M012025	msg_send_res_wait: Message response from this task
M012030	msg_send_res_wait: Message response status invalid
M012035	slv_audio: volume arg invalid
M013000	slv_read_bytes: Watchdog checksum failure twice in a row
M013005	slv_read_bytes: Non-watchdog Checksum failure
M013010	slv_cmd_watchdog: Watchdog echo invalid twice in a row
M013015	slv_cmd_create: Create command invalid
M013020	slv_cmd_read: Read command invalid
M013025	slv_cmd_start: Start command invalid
M013030	slv_cmd_stop: Stop command invalid
M013035	slv_cmd_audio: Audio command invalid
M013040	slv_cmd_restart: Restart command invalid
M013045	slv_cmd_failsafe: Failsafe command invalid
M013050	slv_sup: failsafe invalid message
M013051	slv_sup: failsafe master motor test too long
M013052	slv_sup: failsafe code from slave invalid

Master Processor

Error	Description
M013055	slv_tmr_timeout: Slave communications timeout
M013060	slv_cmd_vbctest: Vbctest command invalid
M014000	msg_send_res_wait: Attempt to send msg to self
M014005	msg_send_res_wait: Message failed to send
M014010	msg_send_res_wait: Message no response
M014015	msg_send_res_wait: Message response length invalid
M014020	msg_send_res_wait: Message response type invalid
M014025	msg_send_res_wait: Message response from this task
M014030	msg_send_res_wait: Message response status invalid
M015000	res_send: Message failed to send
M015005	check_periodic_events: Unknown system failsafe
M015010	slv_tsk: Message length invalid
M015015	slv_tsk: Message from this task
M015020	slv_tsk: Message not from mtr tsk or app tsk
M015025	slv_tsk: slave must be stopped to create task
M015030	slv_tsk: requested pulses_per_second too low or too high
M015035	slv_tsk: slave step size out of tolerance
M015040	slv_tsk: slave interval out of tolerance
M015045	slv_tsk: slave must be stopped to start
M015050	slv_tsk: slave must be dosing to stop
M015055	slv_tsk: Message type invalid
M015060	slv_tsk: Slave task failed to wake up
M016000	invalid index to crc data
M016005	first check of stack guard failure
M016010	second check of stack guard failure
M016015	sys task failed to wake up OR serial communication overrun
M016020	dynamic check variable bad
M016025	sys_tsk: bb_run_task failure
M016030	sys_tsk: bb_run_task failure
M016035	sys_tsk: bb_run_task failure
M016040	sys_tsk: bb_run_task failure
M016045	sys_tsk: bb_run_task failure
M016050	sys_tsk: bb_run_task failure
M016055	sys_tsk: bb_run_task failure
M016060	sys_tsk: bb_run_task failure
M016065	sys_tsk: bb_run_task failure
M016070	sys_tsk: bb_run_task failure
M016075	sys_tsk: bb_run_task failure
M016100	all_crc_data_closed: open crc data field
M016200	sys_tsk: protected mtr crc failure
M016300	sys_tsk: protected data crc failure
M016400	sys_tsk: protected local crc failure
M017000	bolus: Improper message or mode = NO_MODE
M017005	bolus_start: Improper message
M017010	remote_purge_start: Improper message
M017015	remote_bolus_prog_entries: no min data
M017020	remote bolus_prog_entries: no max data
M017025	remote bolus_prog_entries: no float conversion error
M017030	remote bolus_prog_entries: zero conversion error
M017035	remote bolus_prog_entries: mL conversion error

Master Processor

Error	Description
M017040	remote bolus_prog_entries: mL conversion error
M017045	bolus_start:ml_min mode float conversion error
M017050	bolus_start:other mode float conversion error
M017055	bolus_start: no min data
M017060	bolus_start: no max data
M017065	bolus_start: no float conversion error
M017070	bolus_start: zero conversion error
M017075	bolus_start: no float conversion error
M017080	bolus_start: zero conversion error
M017085	bolus_start: bolus value conversion error
M017090	purge_start: mL min mode float conversion error
M017095	purge_start: other mode float conversion error
M018000	Bad state in tst_aux_lcd_test:
M019000	alarms - non existent alarm
M020000	run_delivery: SAMPLING_EVENT event did not occur
M021000	supply_min_max: datandx arg invalid
M021005	supply_defaults: datandx arg invalid
M021010	supply_defaults: invalid return from default calc routine
M021015	conc mode rate min/max invalid mode
M021020	conc mode u/mL min/max invalid mode
M021025	conc mode mg/mL min/max invalid mode
M021030	dose units min/max invalid mode
M021035	dose MxG min/max invalid mode
M021040	dose MxG/KG min/max invalid mode
M021045	bolus MCG/KG invalid mode
M021050	bolus MG/KG invalid mode
M021055	rate_min_max: conc mode rate invalid
M021060	event_log_dose_rate_change: invalid mode
M022000	get_syringe_data: mfr out of range
M022005	get_syringe_data: syringe index out of range
M023000	command_scan: Command tab size error
M023005	command_legality: Unknown command type
M023010	command_processor: Illegal host_command size
M024000	client_tsk: invalid response length STOP
M024005	client_tsk: process_dropout STOP failure
M024010	client_tsk: invalid response length STOP
M024015	client_tsk: process_dropout STOP failure
M024020	client_tsk: Message size illegal
M024025	client_tsk: process_command failure
M024030	client_tsk: bb_put_message failure
M025000	send_comm_shutdown_message: no transmit wakeup message
M025005	rcv_tsk: no transmit wakeup message
M025010	build_valid_message: failed bb_put_message call
M025015	build_resend_message: failed bb_put_message call
M025025	rcv_tsk: initial delay not completed
M026000	app_tsk: invalid req_mach state
M027000	msg_send_rsp_wait: task tried to send message to itself
M027005	msg_send_rsp_wait: unable to send message to parent task
M027010	msg_send_rsp_wait: task failed to respond
M027015	msg_send_rsp_wait: response length invalid

Master Processor

Error	Description
M027020	msg_send_rsp_wait: response type invalid
M027025	msg_send_rsp_wait: response received from wrong task
M027030	kbd_wait: repeat arg invalid
M028000	cal_vbc_sense TRAP
M028005	update_cal: failed attempt to write to EEPROM
M028010	clr_ad_cal: failed attempt to write to EEPROM
M028015	invalid return from float to field
M028020	invalid return from float to field
M029005	vbc_test: Failure at 45 seconds
M029010	vbc_test: Failure at 55 seconds
M029015	vbc_test: Failure at 120 seconds
M029020	vbc_test: invalid state
M030000	client_tsk: Message size illegal
M030005	send_rcv_app_message: no response from remote command
M030010	send_rcv_app_message: response invalid length
M030015	init_receive: Send message failure
M030020	data_read: invalid state
M030030	data_read: eep write failed
M031000	process_remote_message: Message size illegal
M031005	process_remote_message: No entry in table for remote_command
M031010	process_remote_message: put client response failure
M031015	remote_reset:Improper message
M031020	remote_clr_tots:Improper message
M031025	remote_syringe:Improper message
M031030	remote_prog_entries:remote_program illegal message
M031035	remote_prog_entries: task failed to wake
M031040	remote_start:Improper message
M031045	remote_stop:Improper message
M031050	internal_stop:Improper message
M031055	remote_exit:Improper message
M031065	remote_rate_set:Improper message
M031070	remote_conc_set:Improper message
M031075	remote_dose_set:Improper message
M031080	remote_wt_set:Improper message
M031085	remote_vtbi_set:Improper message
M031090	remote_mode_set:Improper message
M031095	remote_prog: Illegal message for mode
M031100	remote_prog: Message size illegal
M031105	remote_prog: put client response failure
M031110	stat_change: bad status value passed
M031115	stat_change: bad bit number passed
M032000	rtc_read_time:minute value in RTC RAM is invalid.
M032005	rtc_read_time:hour value in RTC RAM is invalid.
M032010	rtc_read_time:day value in RTC RAM is invalid.
M032015	rtc_read_time:year value in RTC RAM is invalid.
M032020	rtc_read_time:month value in RTC RAM is invalid.
M032025	rtc_write_date:year must be between 00 and 99
M033000	confirm_dsp_timeout:bad state value
M033005	run_params_calc: machine_mode arg invalid
M033010	purge_bolus_params_calc: machine_mode arg invalid

Master Processor

Error	Description
M034000	power_sensors: sensor_power arg invalid
M034005	srv_ad: channel arg invalid
M034010	A/D Read not from motor task
M034015	srv_ad: timeout waiting for read ready bit
M035000	check_batt_status: Force voltage out of range
M035005	check_batt_status: Delta Force voltage out of range
M035010	text_dsp_check_syringe: Bad check type specification
M035015	bolus_tot_wght_dsp: Invalid mode
M035020	vol_limit_dsp: Float to field failure
M036000	run_delivery: SAMPLING_EVENT event did not occur
M036005	purge_bolus_delivery: SAMPLING_EVENT event did not occur
M036010	run_edit_prog_entries: invalid return key from data entry routine
M036015	run_edit_entry_select: field contains invalid data after editing
M036020	check_max_pressure: Timer read failure
M036025	run_delivery: Confirm display timer read failure
M036030	run_delivery: Rate display timer read failure
M036035	run_delivery: Edit warning timer read failure
M036050	run_delivery: Auto lock timer read failure
M036055	purge_bolus_delivery: Edit warn timer read failure
M037000	bolus_prog_entries_inner: invalid key returned from bolus number entry
M037005	edit_prog_entries: invalid return key from number entry routine
M037010	edit_entry_select: field contains invalid data after editing
M037015	get_next_entry_select: invalid key
M037020	bolus_number_entry: float to field failed
M037025	bolus_number_entry: float to field failed
M037030	bolus_number_entry: float to field failed
M037035	bolus_number_entry: float to field failed
M037040	bolus_number_entry: float to field failed
M037045	bolus_number_entry: float to field failed
M037050	bolus_number_entry: float to field failed
M037055	bolus_number_entry: float to field failed
M037060	bolus_number_entry: float to field failed
M037065	bolus_number_entry: float to field failed
M037070	bolus_number_entry: float to field failed
M037075	bolus_number_entry: float to field failed
M037080	bolus_number_entry: float to field failed
M037085	bolus_number_entry: float to field failed
M037090	bolus_number_entry: float to field failed
M037095	bolus_number_entry: float to field failed
M037100	bolus_number_entry: float to field failed
M037105	purge_total_display: float to field failed
M038000	edit_library_group_select: invalid ndx
M038005	create_protocol: invalid mode selected
M038010	modify_proto: reached default in switch
M038015	modify_proto: invalid mode selected
M038020	delete_proto: reached default in switch
M038025	modify_lib: reached default in switch
M038030	delete_lib: reached default in switch
M038035	create_protocol: reached default in switch
M038040	create_library: reached default in switch
M039000	get_next_valid_config: arg invalid

Master Processor

Error	Description
M039005	get_next_valid_config: key invalid
M039010	get_next_valid_config: no bits found
M039015	set_config_status: arg out of range
M039020	get_config_status: arg out of range
M039025	get_user_response_hml: should never get here
M039045	edit_unit: arg out of range
M039050	set_date_time: bad state
M039055	config_group_select: failed attempt to write to EEPROM
M039060	config_group_select: invalid ndx
M039065	review_group_select: invalid ndx
M039070	save_defaults: eep_put failure
M039075	config_defaults: eep_put failure
M040010	get_text_msg: line arg invalid
M040015	put_text_msg: line1 too long
M040020	put_text_msg: line2 too long
M040025	get_text_msg: line1 ndx invalid
M040030	get_text_msg: line2 ndx invalid
M040040	put_text_msg: a task other than app_tsk called this
M041020	update_lib: EEP write failed
M041030	prot_select: reached switch default
M041035	lib_select: reached switch default
M041040	proto_wait_kbd: timer read failed
M041045	prog_select_lib: reached switch default
M041050	save_protocol: eep put failure
M043000	round_up_to_msd: loc_float arg invalid
M043005	round_up_to_msd: loc_float arg invalid
M043010	app_sup1: invalid syringe mfgr or size
M043015	app_supl: floor_ceil_round invalid field width 1
M043020	app_supl: floor_ceil_round invalid field width 2
M043025	app_supl: floor_ceil_round invalid round type
M043035	app_supl: float_to_field ( ) input value out of range
M044000	program: SAMPLING_EVENT event did not occur
M044005	select_syr_mfgr: invalid index to syringe mfgr table
M044010	prog_entries: invalid return key from data entry routine
M044015	float_to_field return value failed
M044020	float_to_field return value failed
M044025	float_to_field return value failed
M044030	float_to_field return value failed
M044035	float_to_field return value failed
M044040	float_to_field return value failed
M044045	float_to_field return value failed
M044050	float_to_field return value failed
M044055	float_to_field return value failed
M044060	float_to_field return value failed
M044065	syringe_select: invalid state in state machine
M044070	float_to_field return value failed
M045000	write_event: A loggable event occurred before initialization of event system
M045005	write_event: Illegal event type specified
M045010	read_event: A read of events occurred before initialization of event system
M045015	read_event: Bad pointer passed
M045020	read_event: Bad log type specified as parameter
M045025	init_event: attempt to reinitialize the event log system
M045030	event_status_change: Illegal bit_num parameter passed to event_status_change
M046000	res_send: unable to send response

Master Processor

Error	Description
M046005	app_watchdog_tmr_timeout: application failed to communicate
M046010	stepping_tmr_timeout: motor step failed to finish
M046015	checks: excessive forward motor creep
M046020	checks: excessive reverse motor creep
M046025	sys_tsk: flash crc failure
M046030	mtr_tsk: invalid motor interrupt
M046035	mtr_tsk: ideal pulses - actual pulses >= max_actual_pulses_under
M046040	mtr_tsk: actual pulses - ideal_pulses >= max_actual_pulses_over
M046045	mtr_tsk: FS_SET failed set
M046047	mtr_tsk: SYS_FS while waiting for FS_SET
M046050	mtr_tsk: task state invalid
M046055	mtr_tsk: response process invalid
M046060	mtr_tsk: message length invalid
M046065	mtr_tsk: message destination invalid
M046070	mtr_tsk: message source invalid
M046075	mtr_tsk: tried to create too many motor control blocks
M046080	mtr_tsk: duplicate motor control block
M046085	mtr_tsk: requested pulses_per_second too low
M046090	mtr_tsk: requested pulses_per_second too high
M046095	mtr_tsk: requested pulses too low or too high
M046100	mtr_tsk: motor must be stopped to kill control block
M046105	mtr_tsk: tried to kill invalid motor control block
M046110	mtr_tsk: message type invalid
M046115	mtr_tsk: task failed to wake up
M046120	mtr_tsk: IPDM, too many A/D counts in window
M046125	mtr_tsk: IPDM, too many pulses in window
M047000	remote_purge ILLEGAL KEY RETURN
M047005	remote_bolus ILLEGAL KEY RETURN
M047010	purge_bolus_delivery: SAMPLING_EVENT event did not occur
M048000	bb_put_msg fail on send_alarm
M048005	bb_put_msg fail on send_delay
M048010	bb_put_msg fail on send_silence
M049000	calc_dose_from_rate: Invalid mode
M049005	calc_dose_from_rate: Invalid dose
M049010	bolus_ml_calc: Invalid mode
M049015	validate_entries: Invalid data
M049020	validate_entries: Invalid conversion

Slave Processor

Error	Description
L000001	communications timeout
L000002	bad checksum received
L000003	invalid command received
L000004	stack overrun
L000005	execution out of bounds
L000006	short watchdog early
L000007	short watchdog late
L000008	long watchdog early
L000009	long watchdog late
L000010	motor_on pulse timeout
L000011	motor step late
L000012	motor step without Start command
L000013	accuracy out of high tolerance
L000014	accuracy out of low tolerance
L000015	too many pulses before first Hall transition
L000016	too many pulses between first Hall 2 transition and first Hall 1 transition
L000017	first Hall 1 transition too soon after first Hall 2 transition
L000018	too many pulses between first Hall 1 transition and first Hall 2 transition
L000019	first Hall 2 transition too soon after first Hall 1 transition
L000020	Hall 1 pulse count high
L000021	Hall 1 pulse count low
L000022	Hall 2 pulse count high
L000023	Hall 2 pulse count low
L000024	excess motor creep
L000025	unexpected hardware timer timeout
L000026	no failsafe following power-up
L000027	unable to reset failsafe following power-up
L000028	unable to latch failsafe / hardware timer
L000029	hardware timer timeout too short
L000030	unable to reset failsafe from hardware timer
L000031	excessive encoder pulses / hardware timer test
L000032	unable to latch failsafe / low +5 regulated voltage test
L000033	unable to latch failsafe / high +5 regulated voltage test
L000034	unable to latch failsafe / slave failsafe test
L000035	timeout waiting for delivery failsafe self-test
L000036	unable to reset failsafe from excessively low regulated voltage
L000037	unable to reset failsafe from excessively high regulated voltage
L000038	unable to reset failsafe from excessively low regulated voltage
L000039	excessive encoder pulses / failsafe circuit test

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7.1 GENERAL

This chapter contains a detailed description of the disassembly and assembly procedure for the Auto Syringe® AS50 Infusion Pump. Contact Baxter Healthcare Corporation, Andover Service Center if you have any questions while servicing the pump.

NOTES

When performing the procedures of this chapter, exercise extreme caution during disassembly to protect the circuit boards from static discharge. The inspection or repair station, all equipment, and personnel are to be grounded.

During disassembly, note the orientation of all assemblies, assembly parts, cables and connectors. Failure to do so may result in improper operation and/or damage to the pump upon reassembly.

During disassembly, keep track of all hardware and ensure that all parts are kept in a safe place. Avoid leaving loose hardware in the pump upon reassembly. Failure to do so may result in improper operation and/or electrical damage to the circuit boards.

Calibration must be performed after reassembly. Refer to Chapter 5 for the Calibration Procedure.

All pumps must pass the functional tests in Chapter 4 after repair is complete.

WARNING

The pump may only be repaired by replacing the parts or sub-assemblies listed in Appendix C. There are no user-repairable parts or sub-assemblies. Service must be performed by a trained biomedical engineering technician.

7.2 DISASSEMBLY PROCEDURES

Unless specified, the procedure to reassemble a component or an entire assembly is the reverse of the disassembly procedure.

Numbers in parenthesis refer to the numbered parts of the drawing associated with the procedure.

7.2.1 End Caps

- To remove each End Cap (1), lift up the corners of the End Cap (1) and slip them over the molded flanges. During reassembly, ensure that the two feet of each End Cap (2) face towards the back of the pump.

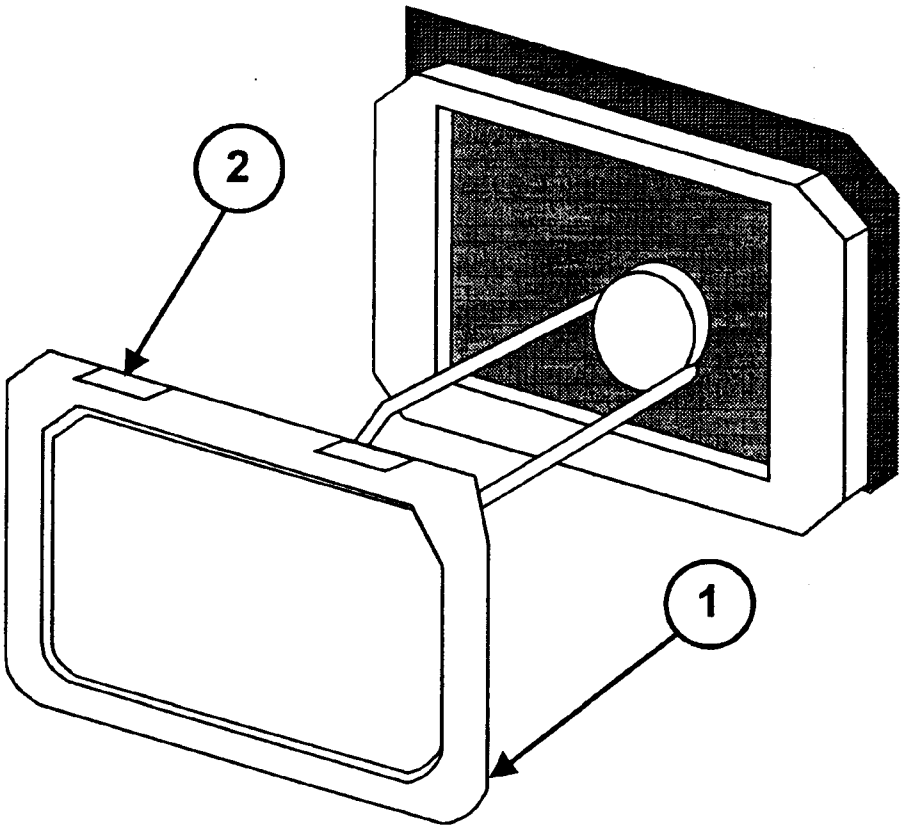


Figure 7-1 End Cap Removal

7.2.2 Pole Clamp

NOTES

To prevent the pole clamp mounting screw and the stainless steel washer from separating from the Pole Clamp mounting plate, do not remove the retaining ring attached to the mounting screw.

The pole clamp cradle is connected to the pole clamp mounting plate with one screw. If this screw is removed, the cradle may be rotated 90 degrees and reconnected. This feature allows the pole clamp to mount onto horizontal or vertical IV poles.

1. Loosen the pole clamp mounting screw (1) until the screw fully retracts and separates from the pump.

2. Remove the Pole Clamp (2).

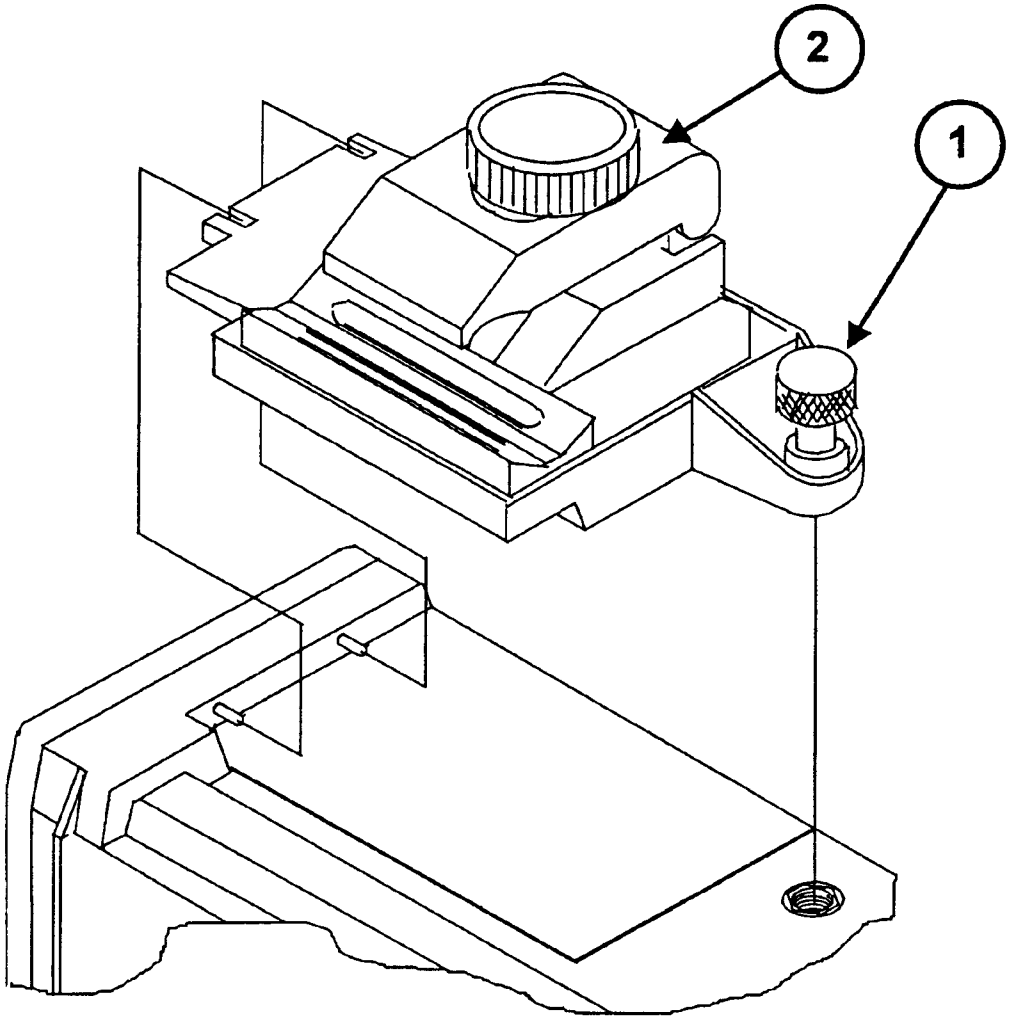


Figure 7-2 Pole Clamp Removal

7.2.3 Battery Stack Replacement

1. Remove the three black screws (3) at the side of the Battery Cover (2).

2. Place thumb on thumb press of the Battery Cover (2) and apply slight pressure while sliding the Battery Cover (2) away from the pump. Remove the Battery Cover (2).

3. Turn the pump over to allow the Battery Stack Assembly to release from the battery compartment being careful not to allow the stack to fall from the case or stress the harness. Disconnect the wire harness at the stack by pressing the latch tab and releasing the connector.

4. Inspect the foam compartment liner used to cushion the Battery Stack assembly. If there is evidence of moisture inside the pump, remove the foam insert and dry out the pump interior with filtered, warm air. Do not allow any foreign material to enter the pump and keep the temperature below 45°C (113°F). When replacing the Battery Stack Assembly (1), write the date replaced on the new Battery Stack Assembly (1) in permanent ink.

5. Connect the Battery Stack Assembly (1) to the wiring harness and ensure that the latch tab is well seated. Place the Battery Stack Assembly (1) into the battery compartment. During installation, do not crush or kink the wire harness leads while dressing them along the sides of the stack.

6. Slide the Battery Cover (2) onto the case. Ensure that the cover fits cleanly on all edges. Install the three black screws (3) being careful not to overtighten them.

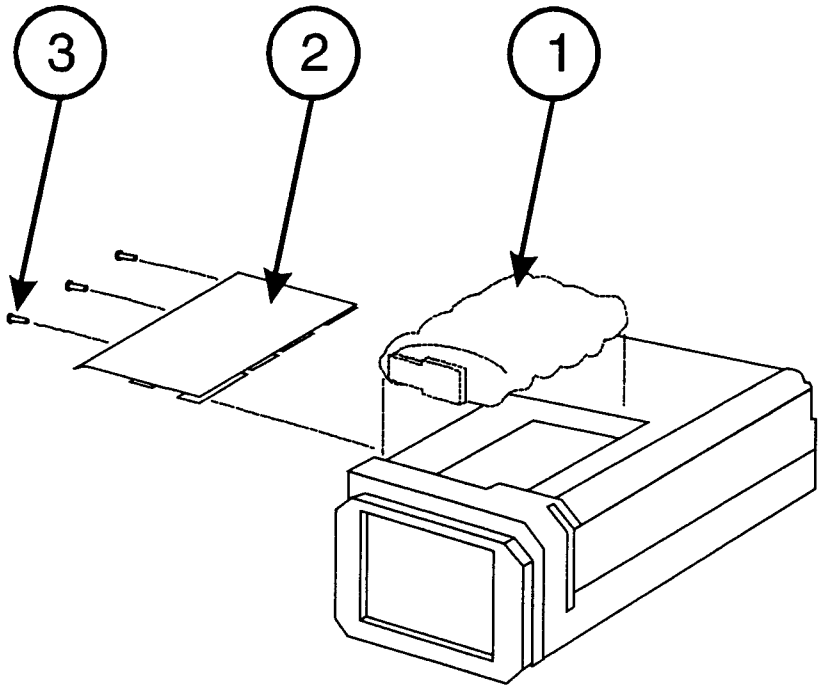


Figure 7-3 Battery Stack Replacement

7.2.4 Barrel Clamp Assembly

7.2.4.1 "Barrel Clamp Assembly" Removal

1. Refer to the side, rear, and exploded views on this page, as necessary, during this and all remaining steps in this section. Open the barrel clamp using either the primary (1) or secondary (2) brake lever.

2. Lay the pump face down on a smooth surface so that the words "PRESS HERE" (appearing upside down) on the Clamp Face Decal (3) face the outside edge of the work surface.

3. Remove the three black Flat Head Screws (4) holding the Barrel Clamp Assembly (5) to the Case Assembly (6).

4. Use the left hand to hold the pump down against the work surface and apply slight downward pressure on the barrel clamp slide (7) (using palm of right hand) until the far end of the clamp (end closest to ON/OFF switch) lifts up approximately 1" from the pump.

5. Using the left hand, continue to hold the pump against the work surface. Grasp the base (8) of the clamp between the thumb and index finger of your right hand and lift the clamp away from the pump.

NOTE

The clamp should easily lift away from the pump. If it does not, the far end of the clamp has not been lifted high enough.

6. Remove the Barrel Clamp Zebra Strip (9) from the pocket on the case located below the zebra strip support (10). Discard the strip. During reassembly, a new Barrel Clamp Zebra Strip (9) is to be installed.

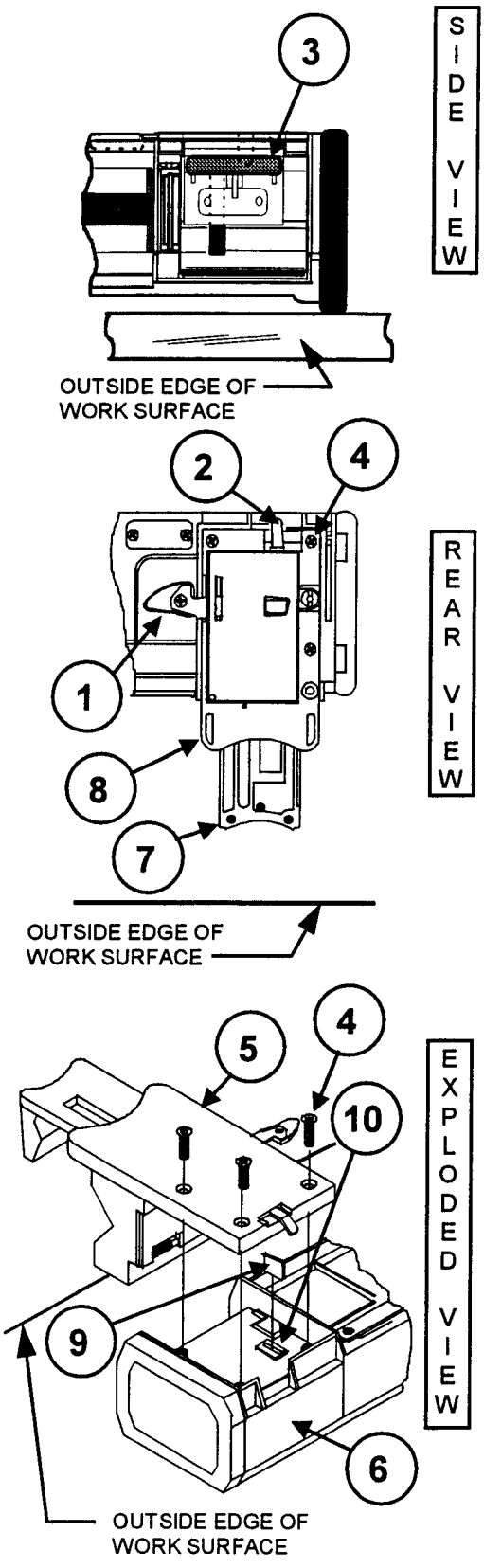


Figure 7-4 Barrel Clamp Assembly Removal

7.2.4.2 Specific Barrel Clamp Assembly Instructions

1. Place a new Barrel Clamp Zebra Strip (1) in the pocket on the pump located beneath the zebra strip support (2). Ensure that, during installation, the metallic strips face toward the top of the pump.

2. Lay the pump face down on a smooth surface so that the pump's plunger driver (3) is facing the outside edge of the work surface. With the Barrel Clamp Assembly (4) positioned so that the words "PRESS HERE" on the Clamp Face Decal also face the outside edge of the work surface, gently place the Barrel Clamp Assembly (4) into the recessed area on the case (5).

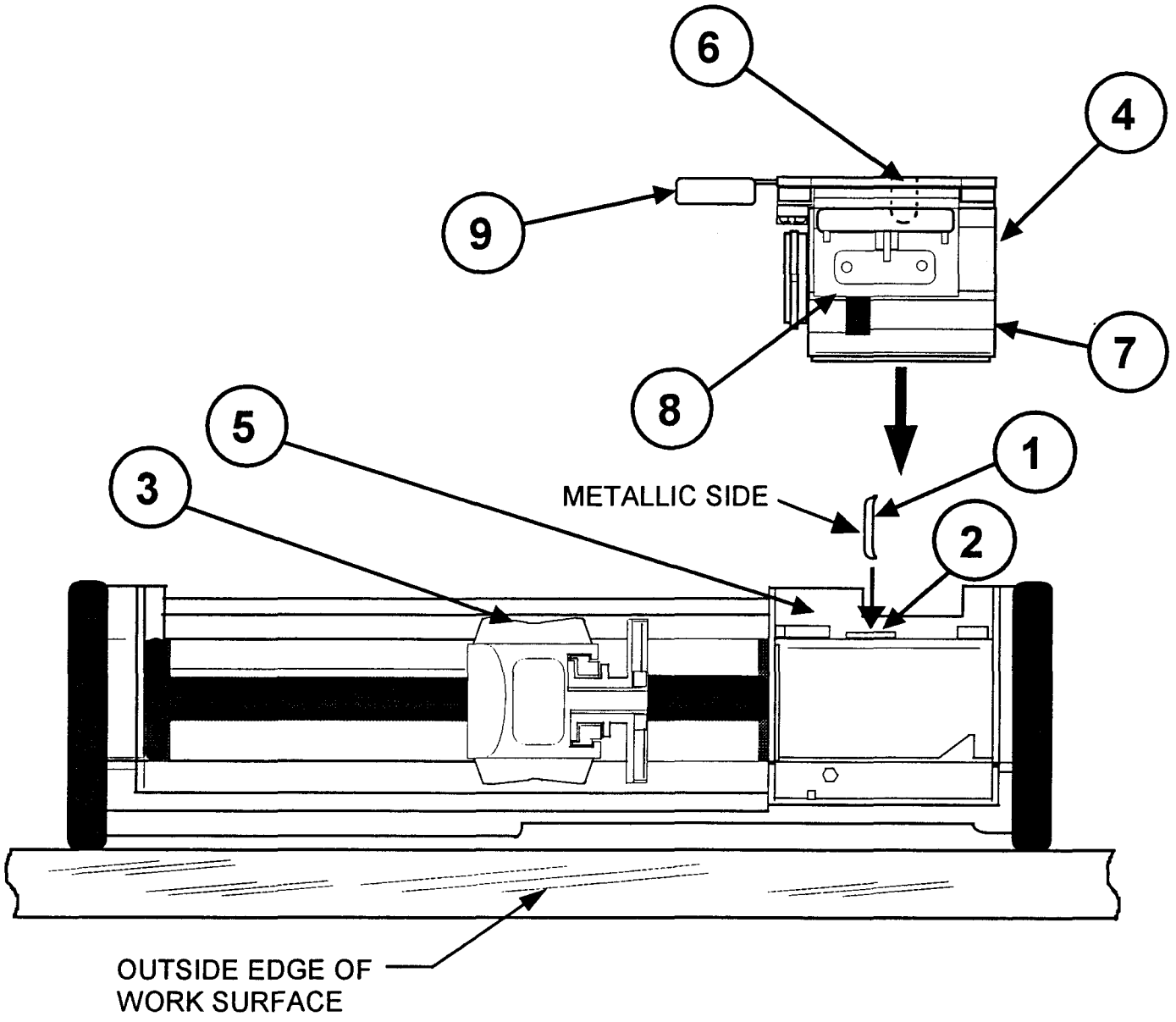


Figure 7-5 Barrel Clamp Assembly Installation

3. Without moving the pump, position the index fingers of both hands on the secondary brake lever (6) of the Barrel Clamp Assembly (4) and position the thumbs of both hands on the cradle (7) of the Barrel Clamp Assembly. Apply inward and downward pressure against the cradle (7) until the clamp snaps onto the case. If the clamp and case were in perfect alignment when the clamp was placed on the case, the snap may not be heard.

4. To confirm that the Barrel Clamp Assembly (4) is properly assembled to the case (5), position the fingers of either hand below the Face (8) of the Barrel Clamp Assembly (4) and attempt to lift the Barrel Clamp from the pump. The clamp should not separate from the pump. If it does, repeat steps 3 and 4.

5. Exercise the Barrel Clamp Assembly (4) by closing the clamp and alternately using both primary (9) and secondary (6) release (brake) levers to open the clamp. Ensure that the clamp opens and closes fully.

Recalibration is required once the Barrel Clamp is reassembled to the Case. Refer to Chapter 5.

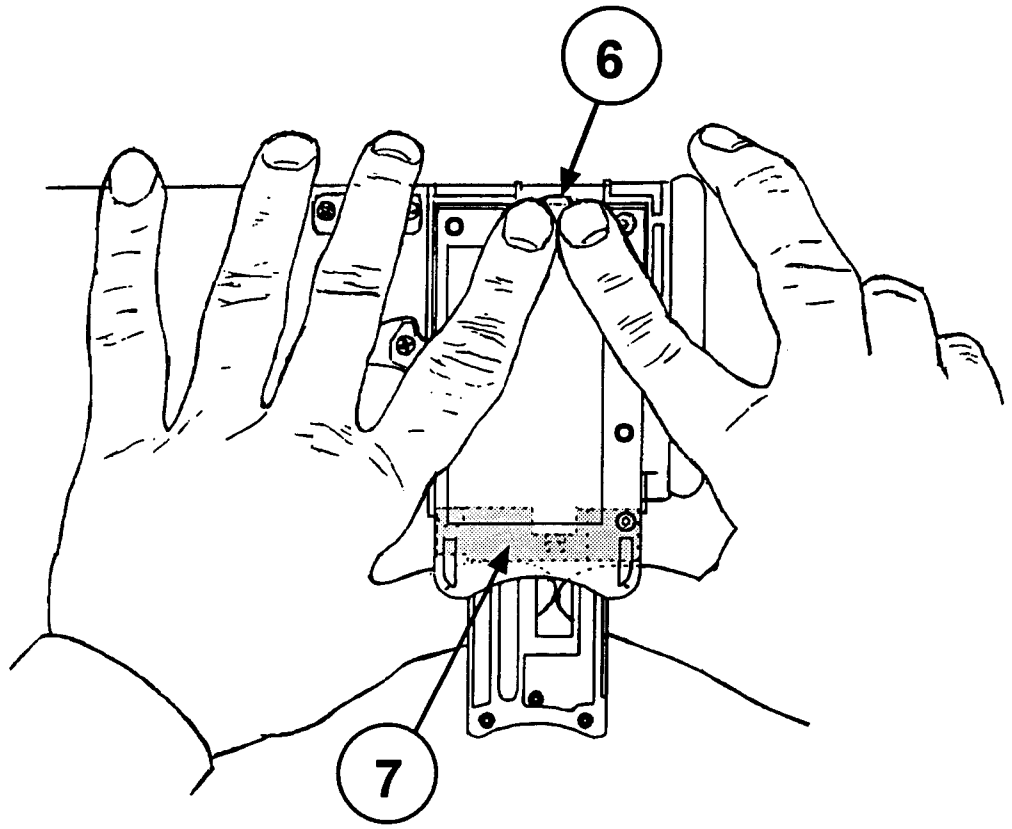


Figure 7-6 Seating of the Barrel Clamp Assembly to the Case

7.2.4.3 Barrel Clamp Face

1. Remove the three socket head cap screws (1) securing the Barrel Clamp Slide (2) to the Barrel Clamp Face (3). Observe that the screw removed from the center of the clamp is longer than the other two screws removed.

2. Separate the Barrel Clamp Face (3) from the Barrel Clamp Slide (2).

NOTE

If the Barrel Clamp Face is to be replaced, affix a new Clamp Face Decal (4) onto the replacement.

7.2.4.4 Molded Lever End

1. Unscrew and remove the flat head screw (5) and hex nut (8) securing the Molded Lever End (6) to the primary brake lever (7).

2. Separate the Molded Lever End (6) from the primary brake lever (7).

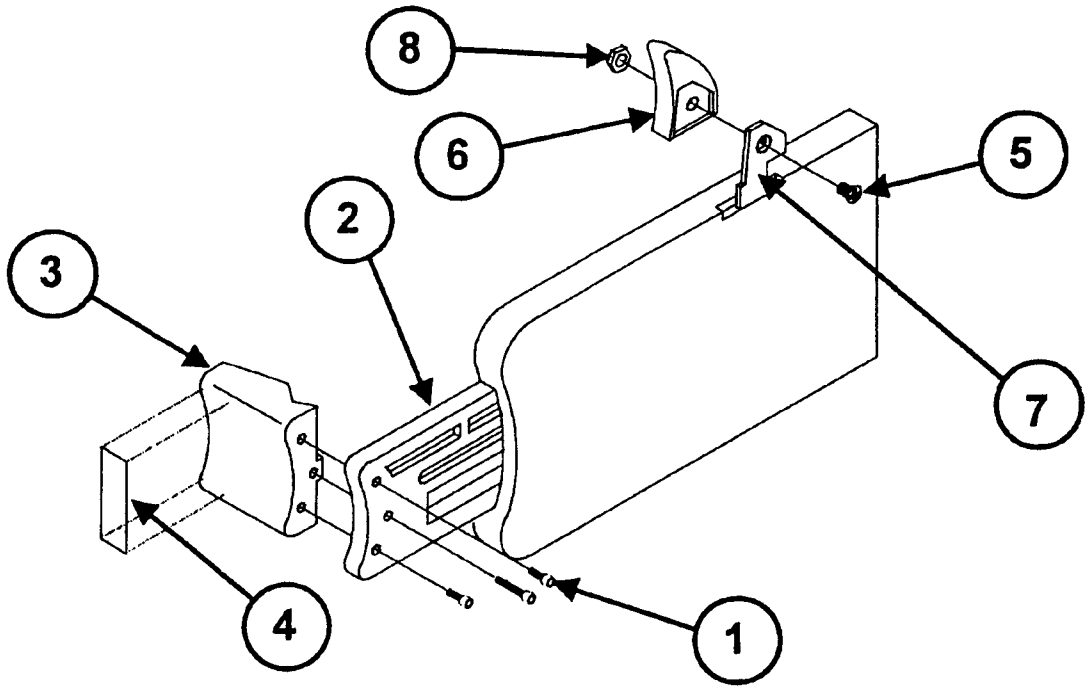


Figure 7-7 Barrel Clamp Face and Molded Lever End Replacement

7.2.5 Cover and Case Assemblies (refer to Figures 7-8 and 7-9)

CAUTION

Three ribbon cables and two flexible cables electrically connect the Cover Assembly (2) to the Case Assembly (3). To prevent any of these cables from sustaining damage, exercise extreme care when separating or joining these assemblies.

1. Remove the End Caps by following the procedure in section 7.2.1.

   Remove the Pole Clamp by following the procedure in section 7.2.2.

   Remove the Battery Stack by following the procedure in section 7.2.3.

   Remove the Barrel Clamp by following the procedure in section 7.2.4.

2. Remove the four screws (1) holding the Cover Assembly (2) to the Case Assembly (3).

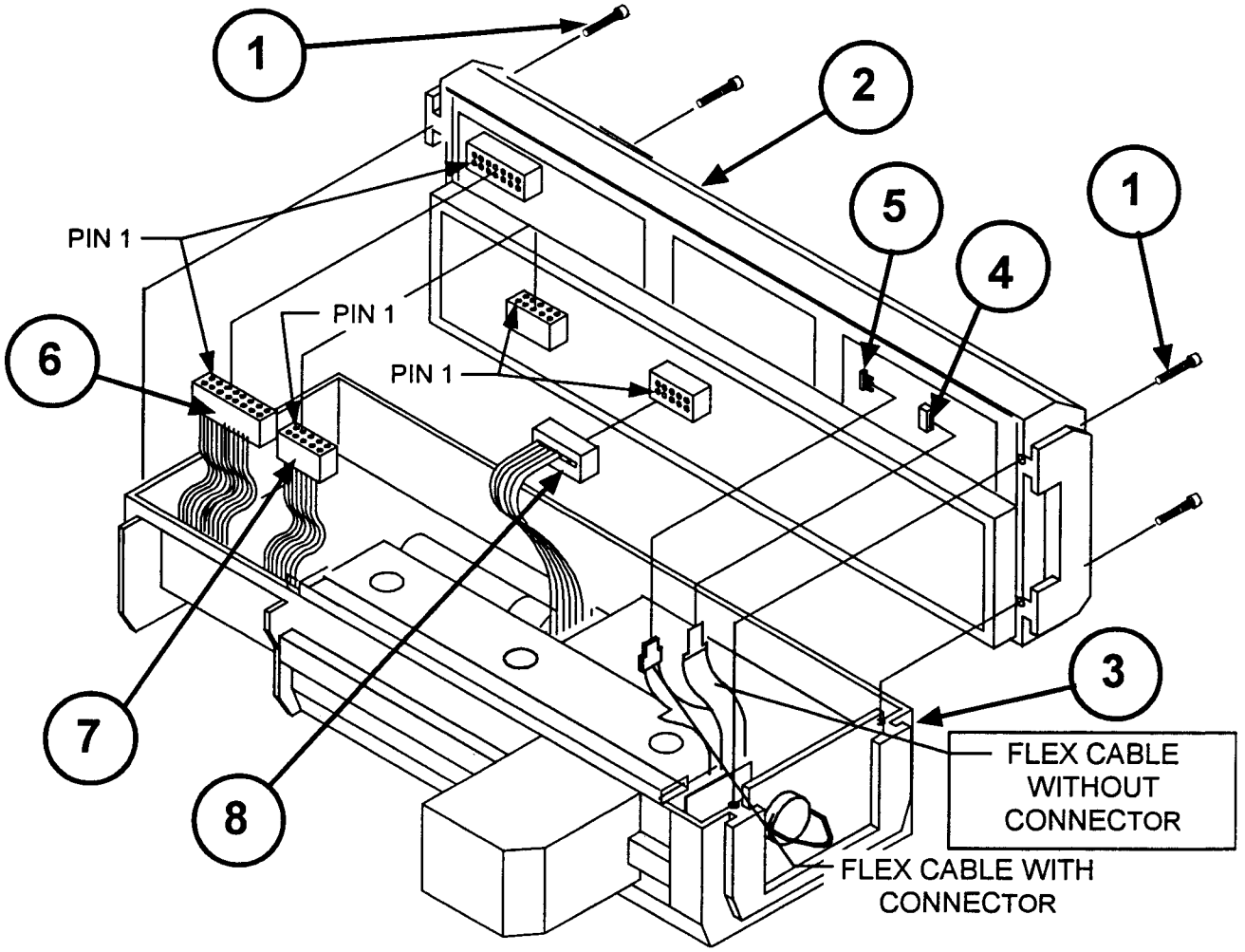


Figure 7-8 Cover and Case Assemblies

CAUTION

The flexible conduit cables are extremely delicate and must be handled carefully. Do not bend these cables excessively near their connectors on the Digital PCB. To properly release the flexible cable from J4, the ZIF (zero insertion force) connector, the actuator (white housing) of the connector must be unlocked by sliding it over the conduit towards the top of the cover. Also, during installation, ensure that the flexible conduit cable is fully inserted into J4 prior to closing the actuator. When the cable is fully inserted into J4, none of the contacts on the cable will be visible.

3. Carefully lift the cover and separate the following connectors:

- J4 ZIF connector (4) on Digital PCB (flex cable without connector);
- J7 connector (5) on Digital PCB (flex cable with connector);
- Sixteen pin ribbon connector (6) on Digital PCB;
- Ten pin ribbon connectors (7) and (8), both on Analog PCB.

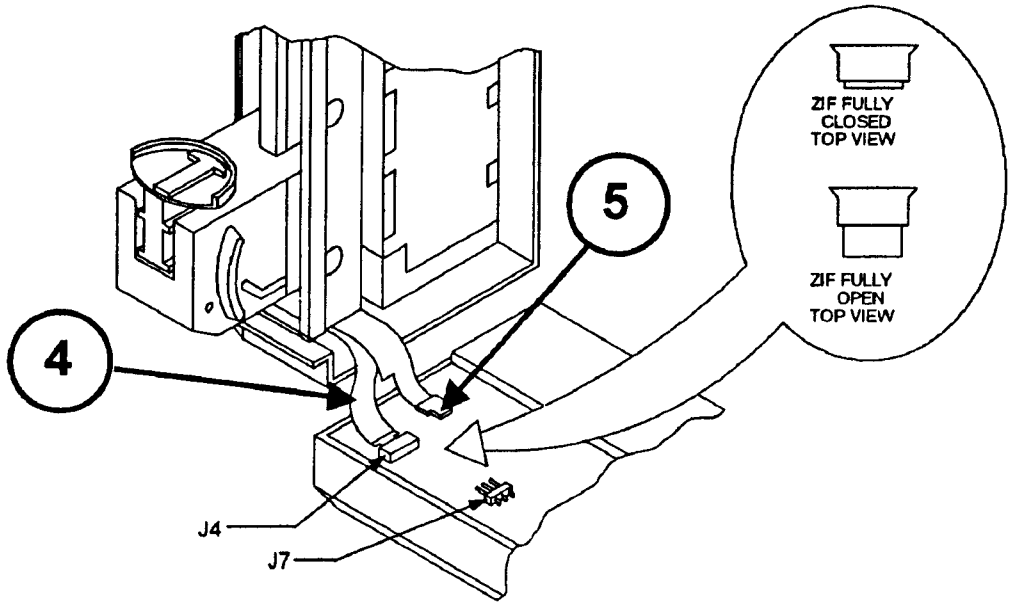


Figure 7-9 Flexible Conduit Connections

7.2.6 Cover Assembly

1. Remove the End Caps, Pole Clamp, Battery Stack, and Barrel Clamp by following the procedures in sections 7.2.1 through 7.2.4.

   Separate the Cover Assembly from the Case Assembly by following the procedure in section 7.2.5.

NOTE

When properly engaged, six small tabs protruding out from the cover, lock and hold the keypad and PCB assemblies (including retainers and electronic chassis) in place against the cover. Only two of these tabs are visible and can be easily accessed. The remaining four tabs are hidden from view.

While removing the PCB assemblies, do not allow the keypad to separate from the Digital/LCD Assembly. If it does, the lamp/LED covers may fall out and have to be reinserted. Also, because of the small size of these parts, they are easy to lose.

2. With the keypad and window of the Cover/Window Assembly (1) placed on a smooth surface (grounding mat, etc.) that will not scratch the window, start by releasing the two visible tabs (2) - pushing them away from and under the retainer (3) holding the digital board.

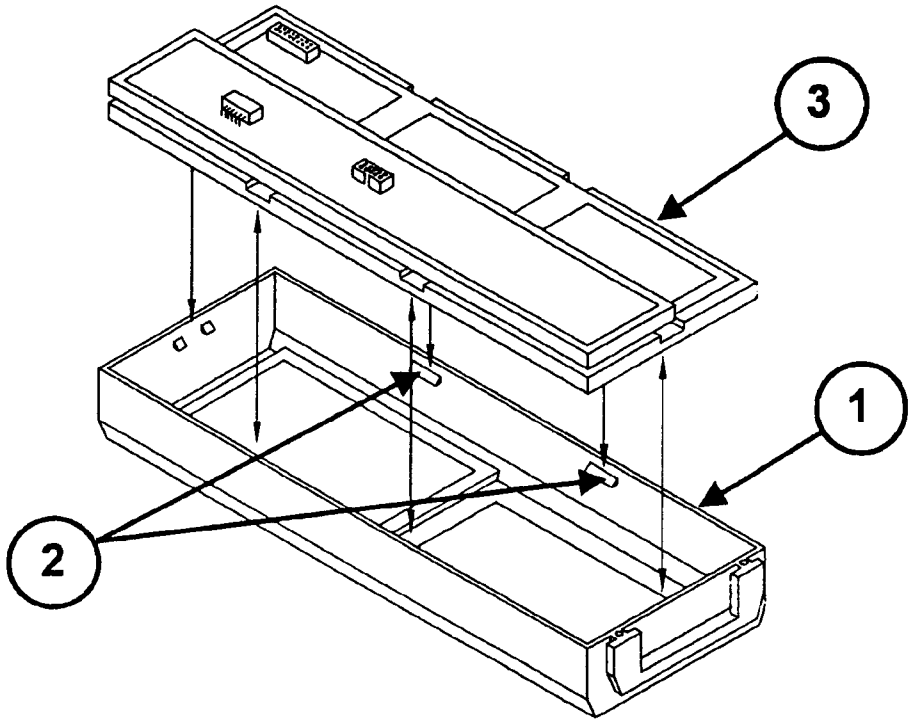


Figure 7-10 Cover Assemblies

3. Using a small flat-blade screwdriver, push and hold the section of the Cover/Window Assembly (1) near the bottom of the keypad away from the retainer (3). Immediately apply light pressure against the keypad to initially disengage the retainer from the Cover/Window Assembly (1).

4. Complete the removal of the PCB assemblies by inserting the screwdriver between the top section of the Cover/Window Assembly (1) near the LCD window and the retainer (3). Pry the Cover/Window Assembly (1) away from the retainer (3) and continue to apply light pressure against the keypad until the PCB assemblies release and become separated from the Cover/Window Assembly (1). Safely set the Cover/Window Assembly aside so that neither the cover nor window become scratched.

NOTE

During reassembly of the PCB assemblies to the cover, confirm there is no visible separation between the edges of the window and the Cover housing. Also confirm that both the window and the LCD screen are clean and free of lint.

7.2.7 Keypad Assembly

1. Remove the End Caps, Pole Clamp, Battery Stack, and Barrel Clamp by following the procedures in sections 7.2.1 through 7.2.4.

   Separate the Top Cover Assembly from the Case Assembly as described in section 7.2.5.

   Remove the PCB assemblies from the Top Cover/Window Assembly as described in section 7.2.6.

2. The Keypad Assembly (1) is held in place against the Digital/LCD Assembly (2) by two small metal tabs protruding out from the bottom upper and lower outer corners of the Keypad's blank PCB. These tabs, hidden from view, are indexed with and inserted into two small holes (3) on the Digital/LCD Assembly. Insert a non-metallic tool having no sharp edges (i.e., soldering aid, etc.) under the edge of the blank PCB to release the metal tabs from the Digital/LCD Assembly (2).

3. Grasp the right side of the Keypad Assembly (1) and pull it away from the three pin (4) and ten pin (5) connectors on the Digital board. Do not use excessive force during the removal process.

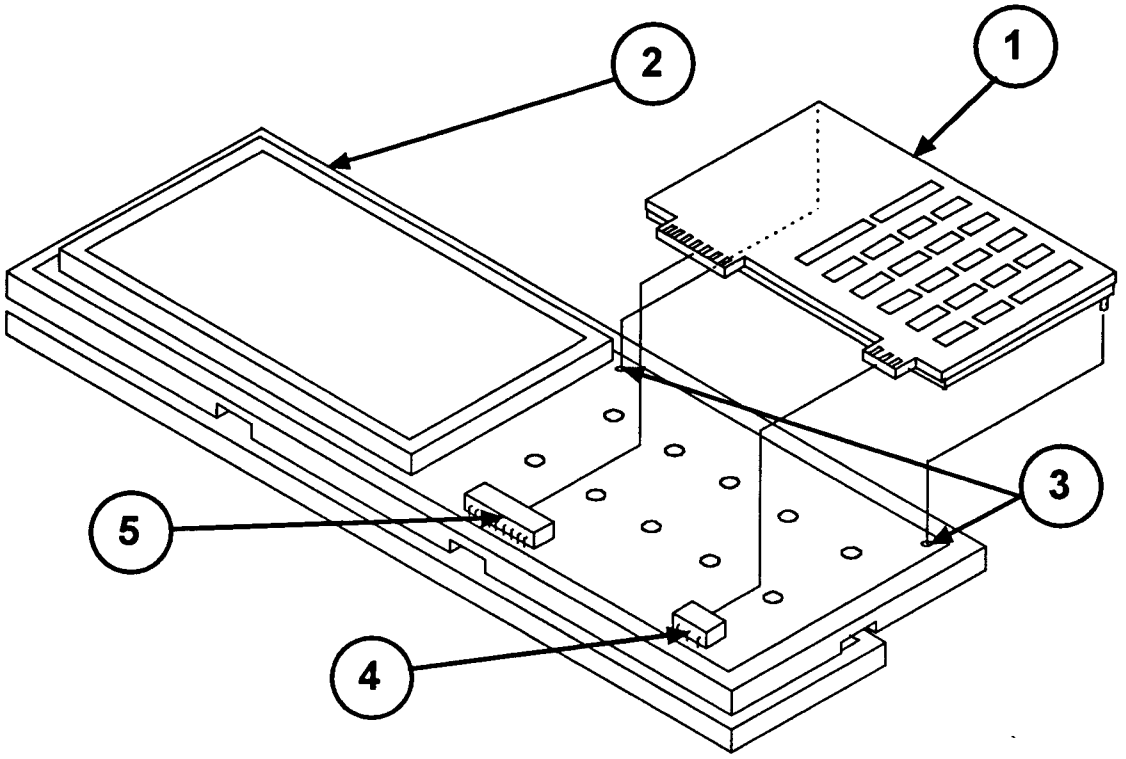


Figure 7-11 Keypad Assembly

7.2.8 Analog and Digital PCB Assemblies

1. Remove the End Caps, Pole Clamp, Battery Stack, and Barrel Clamp by following the procedures in sections 7.2.1 through 7.2.4.

   Separate the Top Cover Assembly from the Case Assembly as described in section 7.2.5.

   Remove the PCB assemblies from the Top Cover/Window Assembly as described in section 7.2.6.

   Although it is not necessary, it is advised to remove the Keypad from the Digital/LCD Assembly as described in section 7.2.7.

2. With the Digital/LCD Assy. (1) resting on a smooth surface (grounding mat, etc.), use a small flat bladed screwdriver to unsnap the Analog PCB Retainer (2) from the Electronic Chassis (3) and set aside the retainer. Observe that the Analog PCB Assembly is protected on all four sides by Conductive Gasket material (4).

3. The Analog PCB Assembly (5) has a hard wired header on its unexposed side which is plugged into the Digital Board assembly (1). Using a non-metallic tool having no sharp edges (i.e., soldering aid tool), loosen the Analog PCB Assembly (5) from this connector.

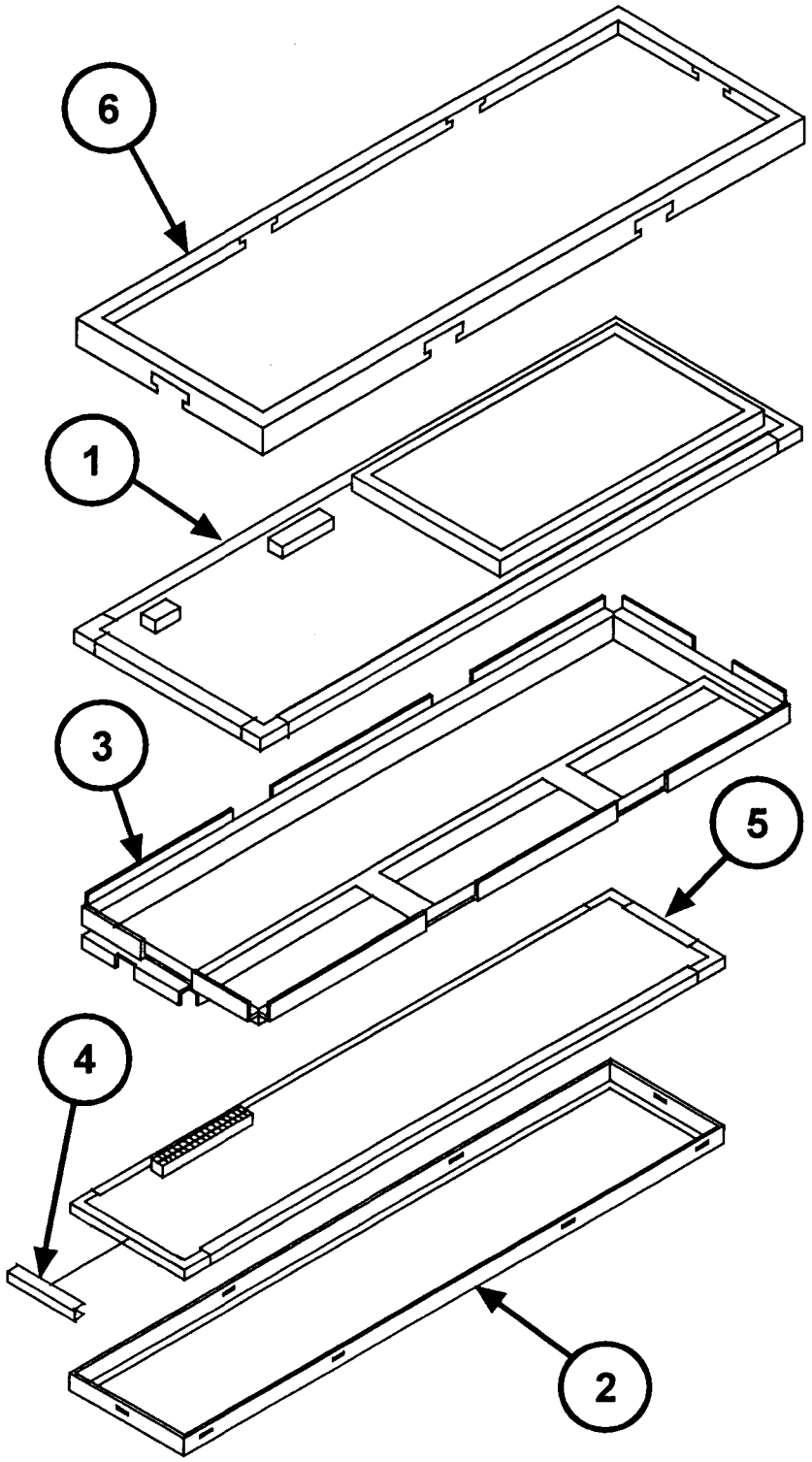


Figure 7-12 Analog and Digital PC Board Assemblies

Then, remove and set aside the Analog PCB Assembly (5) taking care that the Conductive Gasket material (4) does not separate from the PCB.

4. Observe the following:

   - The Digital/LCD Assembly (1) is held to the Electronic Chassis (3) by the Digital PCB Retainer (6).

   - The retainer has six sets of tabs by which it is secured to the electronic chassis.

5. With the Digital/LCD Assembly (1) resting on a smooth surface (grounding mat, etc.), use a pair of needle nose pliers to bend the six (6) sets of tabs on the Digital PCB Retainer out and away from the Electronic Chassis (3).

6. To allow the Digital PCB Retainer (6) to be pulled free, use a small flat blade screwdriver to release the Retainer (6) from the six snap tabs on the Electronic Chassis (3). Use care to prevent the Retainer (6) from deforming.

7. Remove the Digital PCB Retainer (6).

8. Push the Digital/LCD Assembly (1) free of the Electronic Chassis (3) taking care not to lose the Conductive Gasket material (4) surrounding the edges of the PCB.

7.2.9 I/O Board Assembly

1. Remove the End Caps, Pole Clamp, Battery Stack, and Barrel Clamp by following the procedures in sections 7.2.1 through 7.2.4.

   Separate the Top Cover Assembly from the Case Assembly as described in section 7.2.5.

   NOTE

   If the I/O Board Assembly is being replaced, section 7.2.10 must be performed after the replacement is made. If the same I/O Board Assembly is being reassembled to the Case Assembly, section 7.2.10 must not be performed.

2. Remove the Instruction Decal (1) - [see dotted lines] - located above the ON/OFF switch.

3. Remove the two flat head screws (3) used to secure the Speaker (4) to the Case (2). During reassembly, ensure that the speaker wires exit near the bottom of the Case Assembly and are clear of the regulator located on the I/O Board Assembly (5).

4. Remove the two screws (6) that secure the Charger Port Connector (7) to the Case Assembly (2). Remove the Charger Port Connector (7) and the Connector Spacer (8) located between the Charger Port Connector (7) and the Case Assembly (2). When re-assembling these parts, ensure that the connector key and the square corner of the Connector Spacer (8) are positioned closest to the top of the Case Assembly. The wires of the ferrite bead assembly (9) must be routed so as not to interfere with any of the surface mounted components on the I/O board Assembly (5).

5. Remove the two socket head cap screws (10) securing the ON-OFF switch (11) to the Switch Bezel (12) (note the color and position of the wires on the switch contacts prior to removal).

6. Lift the ON-OFF Switch (11), Switch Gasket (13), Switch Retaining Spring (14), and Switch Bezel (12) free of the Case Assembly. During reassembly, ensure that the ON-OFF switch (11) is oriented correctly. Also ensure that the "OFF" letters on the Switch Bezel (12) are located closest to the bottom of the pump housing.

7. If necessary, remove the two screws (15) securing the RS232 Connector Cover (16) to the RS232 port. Then remove the RS232 Connector Cover (16).

8. Free up the two battery stack wires inside the battery compartment and route them through the battery stack opening towards the I/O Board Assembly (5). Ensure that, during reassembly, these wires do not get caught under the I/O Board Assembly (5) and are kept clear of the regulator.

9. Remove eight pan head screws (17) securing the I/O Board Assembly to the Case Assembly.

10. Remove the I/O Board Assembly (5) from the Case Assembly.

NOTE

Ensure that the RS232 Gasket (18) is present on J14 of the I/O Board Assembly.

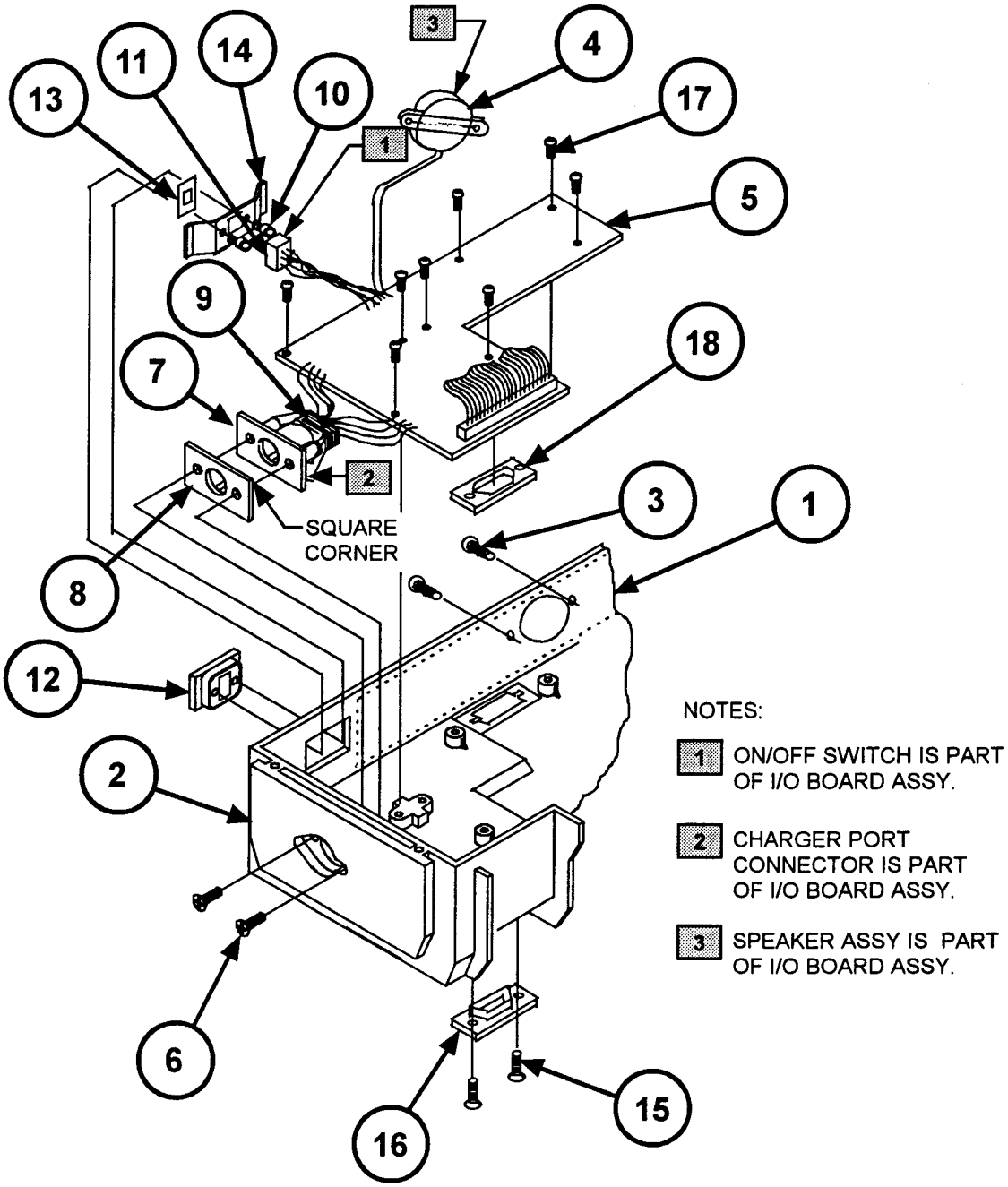

SQUARE CORNER
NOTES:
1 ON/OFF SWITCH IS PART OF I/O BOARD ASSY.
2 CHARGER PORT CONNECTOR IS PART OF I/O BOARD ASSY.
3 SPEAKER ASSY IS PART OF I/O BOARD ASSY.

Figure 7-13 I/O Board Assembly Removal

7.2.10 Setting of Battery Charging Current

NOTE

This section is to be performed whenever the I/O Board Assembly is replaced.

1. Attach an 89 ohm (± .1%, 1 watt) resistor across the terminals of the pump's battery connector (P12).
2. Set a meter to measure DC voltage and connect the meter across the 89 ohm resistor.
3. Confirm that the pump's ON/OFF switch is switched to the **"OFF"** position.
4. Connect the charger to the pump's charger port and plug the charger into a 115 VAC power source.
5. Adjust R100 on the I/O board until the meter indicates 7.40 VDC.
6. Apply Glpt to the adjustment screw on R100.
7. Disconnect the charger, meter and 89 ohm resistor from the pump.

7.2.11 Pole Clamp Hardware

1. Separate the Top Cover Assembly from the Case Assembly as described in section 7.2.5.

2. Remove the pole clamp hardware (Hex Insert (1), 10-32 x .25 Pan Head Screw (2), and .036 Thick Flat Stainless Steel Washer (3)) from the case.

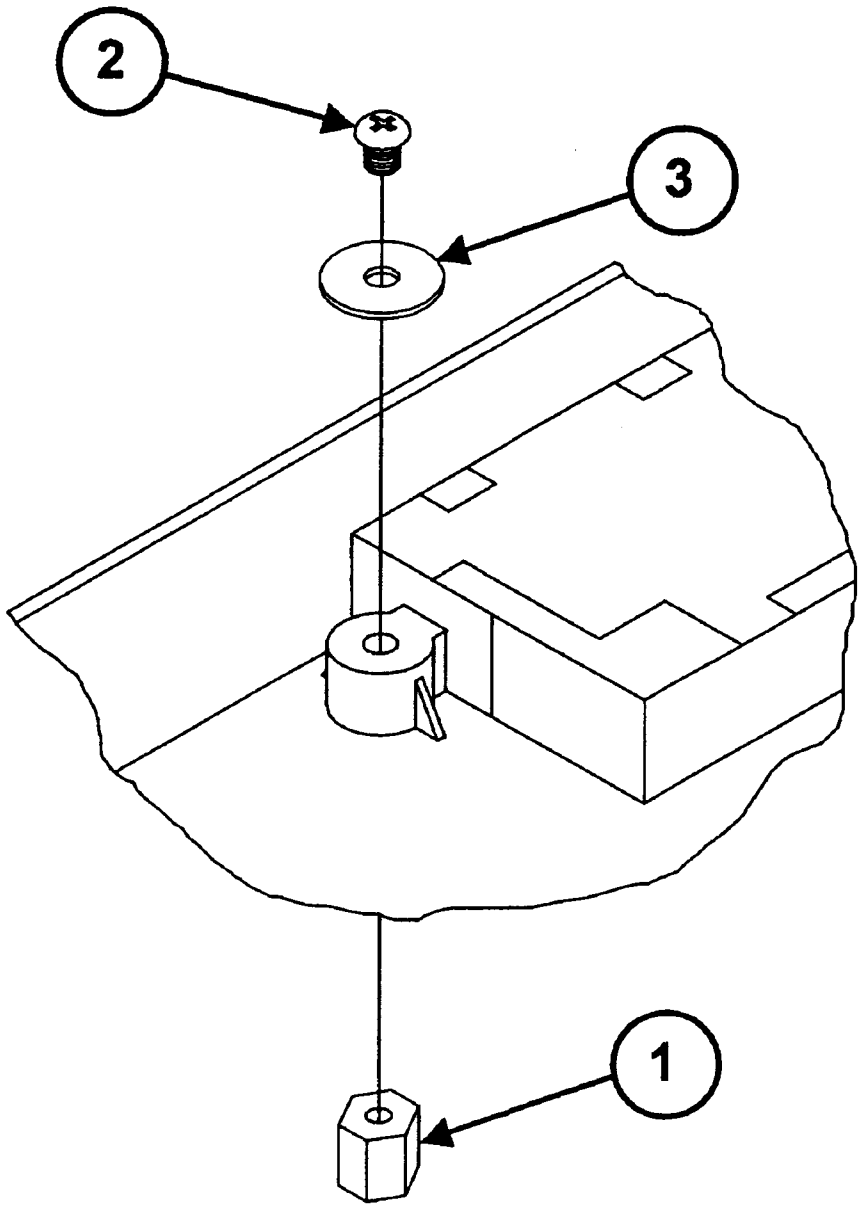
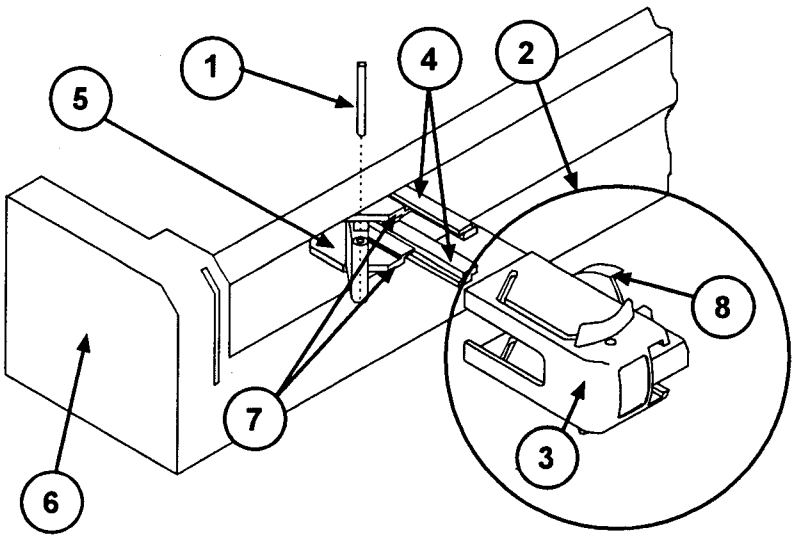


Figure 7-14 Pole Clamp Hardware Removal

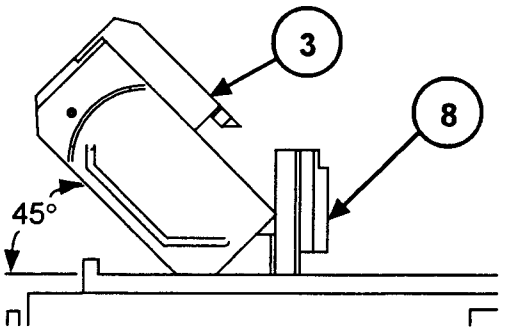
7.2.12 Upper Plunger Assembly

1. Using a 1/16″ punch or equivalent, push the Lever Pin (1) out from the Upper Plunger Assembly (2).

2. Slowly and carefully, pull out the Upper Plunger Assembly (2) until the two channels on the side of the Plunger Driver Slide (3) separate (disengage) from the two side rails (4) on the Plunger Driver Carriage (5). While keeping these parts separated, move the Plunger Driver Slide (3) up towards the top of the pump (6) and then allow the slide to rest on the two small flat sections (7) of the Plunger Driver Carriage (5).



3. Position the pump on the work surface so that the Plunger Driver Slide (3) faces upward. Pivot the slide to the left until it comes to rest at an angle approximately 45° from the Mechanical Drive Assembly. This action allows easy access to the Plunger Driver Face (8).



4. Located on the Plunger Driver Carriage (5) are two interlocking tabs that prevent derailment of the Plunger Driver Face (8) from the Plunger Driver Carriage. Defeat these interlocks by pulling either rail away from the carriage and; while holding this rail away from the carriage, slide the Plunger Driver Face (8) out from the rails.

CAUTION

A Constant Force Spring connects the Plunger Driver Slide (3) to the Plunger Driver Face (8). At this time, do not attempt to pull the Plunger Driver Face (8) away from the Plunger Driver Slide (3).

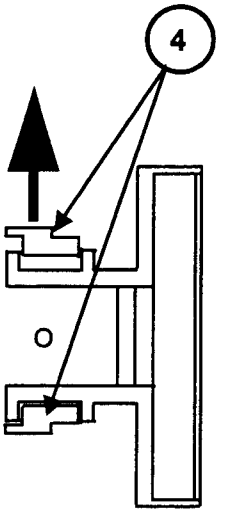


Figure 7-15 Upper Plunger Assembly

5. To separate the Plunger Driver Slide (3) from the Plunger Driver Face (8), use a 1/16″ punch or equivalent to push the Stepped Pin (9) out of the Upper Plunger Assembly (2).

NOTE

After reassembly, confirm that the Plunger Driver Assembly functions properly by exercising this assembly several times.

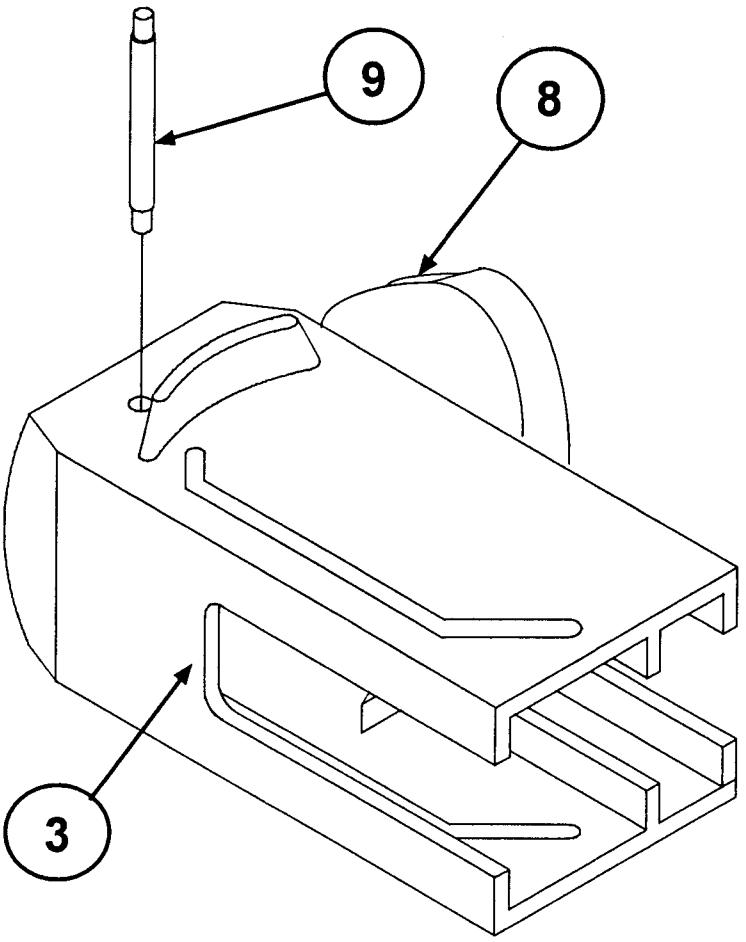


Figure 7-16 Stepped Pin Removal

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8.1 GENERAL

System configuration modes include Configuration Review mode and Configuration Set mode.

NOTE

For a complete listing of the factory default configurations, see the tables at the end of this chapter.

8.2 CONFIGURATION REVIEW MODE

Configuration Review mode allows review of configurable options without risk of altering them.

8.2.1 Activating Configuration Review Mode

To activate Configuration Review mode, press the key sequence 1,2,3 following completion of the **POST**.

8.2.2 Configuration Review Sequence

Following the software version display, the pump prompts for each group of review options by displaying **VIEW <group name>**. **Y** is displayed in the syringe manufacturer field. To access the indicated option group, press **CONFIRM**. To skip to the next group press ▲ or ▼ to change the **Y** to **N** and press **CONFIRM**. Continue to press **CONFIRM** to view each option in a group until the next group prompt appears. Again, use the ▲ or ▼ key to view that group's options.

When the last configuration group option has been reviewed, the pump automatically restarts the **POST**. Also, switching the pump **"OFF"** any time during the review will cancel the review process.

8.3 CONFIGURATION SET MODE

Configuration Set mode is primarily used to select and control configurable options, and provides the following functions:

- create, modify and delete protocol libraries, and control availability of specific protocol libraries
- create, modify and delete protocols
- control access to LIBRARY group functions
- transfer (replication) configuration from pump to pump
- control availability of specific infusion modes
- control availability of specific syringe manufacturers
- control availability of specific syringe sizes

- enable/disable "Default to Previous" feature for protocol library, protocol, mode, and syringe manufacturer
- enable/disable Remote Control feature
- enable/disable Protocol Library feature
- enable/disable Size Override feature
- control occlusion detection sensitivity
- control audio volume range
- control maximum rate of infusion
- enable/disable Auto Lock feature
- enable/control/disable backlight
- select serial port
- enable/disable PUMP IS IDLE alarm feature
- enable/control/disable Near End alert
- enable/disable BOLUS COMPLETE alert
- enable/disable DOSE COMPLETE alarm
- enable/disable Volume Limit feature for ML/HR and ML/MIN modes
- define alphanumeric identifier
- set date/time feature

8.3.1 Activating Configuration Set Mode

To activate Configuration Set mode, press the key sequence 9,8,0,5 following completion of the POST.

NOTE

The pump sounds an error beep for each key. These tones are provided to discourage unauthorized access and may be ignored.

8.3.2 Date and Time Display

On entry to Configuration Set mode the pump initially displays the date and time in the following format:

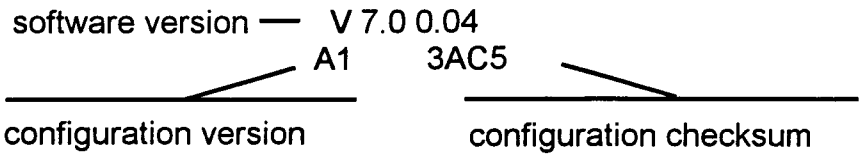
12.00AM
12/13/95

8.3.3 Software Version Display

Following the date and time display, the pump presents the software version display.

The first line of the display indicates the pump software version. The second line is divided into two fields. The left field displays the configuration version, a 2-character code that identifies the format of the configuration data. The right field displays the 4-character configuration checksum, which identifies the entire current configuration file including the protocol library.

The following example shows a software version display for software version 7.00.04, configuration version AI and configuration checksum of 3AC5.



The configuration checksum allows a high-confidence rapid comparison of configuration files between two pumps.

8.3.4 Configuration Set Sequence

Following the software version display, the pump prompts for each group of configuration options by displaying CONFIG <group name>. Y is displayed in the syringe manufacturer field. To access the indicated option group, press CONFIRM. To skip to the next group press ▲ or ▼ to change the Y to N and press CONFIRM.

Unless otherwise indicated below, options within a group are displayed in a similar way. Each option is identified in the text field and a flashing Y, N or other character in the syringe manufacturer field indicates the current configuration of the option. The ▲ and ▼ keys may be used to toggle among the configuration choices and CONFIRM is pressed to complete the setting and proceed to the next option.

When the final option within a group has been configured, the pump displays UPDATING, then the configuration sequence proceeds to the next CONFIG <group name> prompt. The pump restarts the power-on self test (POST) following the final UPDATING display.

NOTES

For the Modes and Manufacturers groups, at least one selection must be made from each group. If no option has been selected after all options in the group have been presented, then, rather than displaying UPDATING, the pump returns to the first selectable option within the group.

For each option group, the updated configuration data is not saved until the UPDATING message has been displayed. The operator may discontinue the configuration process at any time by turning off the pump but entries pending update will be lost.

CAUTION

To prevent corruption of the configuration data, do not turn off the pump while UPDATING is being displayed.

8.4 CONFIGURATION GROUPS

8.4.1 LIBRARY Group

The LIBRARY configuration group allows the operator to create and modify protocols and protocol libraries, and to perform pump-to-pump configuration replication. To select the LIBRARY group, confirm a Y response to the CONFIG LIBRARY prompt.

8.4.1.1 Library Access Code

The pump displays ENTER CODE. Enter the four digit library access code. Pumps are shipped from the factory with a default library access code of "0000".

- If an invalid code is entered the pump issues a CODE MISMATCH alert. Reenter the code correctly. If three CODE MISMATCH errors occur, the pump skips to the CONFIG MODES group prompt.

8.4.1.2 LIBRARY Group Functions

After the library access code is entered, the pump displays ▲ ▼ SELECT FUNCTION. Press ▲ or ▼ to step through the available functions and press CONFIRM to select a specific function. The following function selections are displayed in the sequence shown:

1. QUIT
2. MODIFY PROTOCOL
3. DELETE PROTOCOL
4. MODIFY LIBRARY
5. DELETE LIBRARY
6. CREATE PROTOCOL
7. CREATE LIBRARY
8. CHANGE CODE
9. RECEIVE

All functions except QUIT return to the ▲ ▼ SELECT FUNCTION prompt upon completion. The previous function used is displayed as the first selection.

8.4.1.2.1 QUIT

Selecting QUIT causes the pump to exit the LIBRARY group and continue with the CONFIG MODES prompt.

8.4.1.2.2 MODIFY PROTOCOL

The MODIFY PROTOCOL function allows the operator to modify all information contained in a specific protocol.

If the pump displays ▲ ▼ SELECT LIBRARY, press ▲ or ▼ as necessary to select the library containing the protocol to be edited, and press CONFIRM to complete the selection.

At the ▲ ▼ SELECT PROTOCOL prompt, press ▲ or ▼ to select the protocol to be modified, and press CONFIRM to complete the selection.

Once a protocol has been selected, the pump displays NAME <protocol-name> where <protocol-name> is the name of the selected protocol. Press CONFIRM to accept the current protocol name, or change the name to any name that is not already assigned to another protocol within the same library. Press CONFIRM to complete the protocol name entry.

Next, the pump displays SELECT MODE ▲ ▼. Press ▲ or ▼ to display the infusion mode currently assigned to the protocol. Press <CONFIRM> to accept the current mode, or press ▲ or ▼ as necessary to select a different mode and press CONFIRM to complete mode selection.

NOTES

The pump offers an ALL MODES selection. If this selection is chosen, all infusion modes will be available when the protocol is selected during normal programming.

If ALL MODES, SINGLE DOSE, MANUAL SCHEDULE, AUTO SCHEDULE or CUSTOM DILUTION is selected when CONFIRM is pressed, no further settings are allowed for the protocol. If any changes were made to the protocol, the pump displays UPDATING immediately.

The mode assigned to a protocol will be available when that protocol is selected during normal programming, even if the mode is not enabled in the MODES configuration group.

CAUTION

To prevent corruption of the configuration data, do not turn off the pump while UPDATING is being displayed.

If a mode other than ALL MODES, SINGLE DOSE, MANUAL SCHEDULE, AUTO SCHEDULE or CUSTOM DILUTION is assigned to the protocol, the pump displays additional prompts for any of the following that apply to the mode selected:

- Concentration
- Dose or Rate

At each prompt, the current default value is displayed, or dashes are displayed, if no default value is defined. Use the digits (0-9) and the decimal point (.) as necessary to enter or modify a default value or press CLR to replace the current default value with dashes. Press CONFIRM to complete each entry.

Next, the pump displays ALLOW BOLUS with a Y or N response, indicating respectively that bolus delivery is currently allowed or disallowed by the protocol. Press ▲ or ▼ if necessary to change the response and press CONFIRM to complete this step.

Next, the pump displays a BOLUS SIZE prompt. The current default bolus size is displayed or dashes are displayed if no default value is defined. Use the digits (0-9) and the decimal point (.) as necessary to enter or modify the default value or press CLR to replace the current default value with dashes. Press CONFIRM to complete the entry.

Next, the pump displays a BOLUS MAX RATE prompt for entry of a bolus delivery rate limit. The units for bolus max rate are the same as the dose units (for example, mcg/min for MCG/MIN mode, mL/hr for ML/HR mode, and so forth). The current bolus max rate is displayed or dashes are displayed if no default value is defined. Use the digits (0-9) and the decimal point (.) as necessary to enter or modify the default value or press CLR to replace the current default value with dashes. Press CONFIRM to complete the entry.

When all default settings have been confirmed the pump displays UPDATING.

CAUTION

To prevent corruption of the configuration data, do not turn off the pump while UPDATING is being displayed.

8.4.1.2.3 DELETE PROTOCOL

The DELETE PROTOCOL function allows the operator to delete a protocol.

If the pump displays ▲ ▼ SELECT LIBRARY, press ▲ or ▼ as necessary to select the library containing the protocol to be deleted, and press CONFIRM to complete the selection.

At the ▲ ▼ SELECT PROTOCOL prompt, press ▲ or ▼ to select the protocol to be deleted, and press CONFIRM to complete the selection.

Once a protocol has been selected, the pump prompts the operator to confirm the deletion by displaying DELETE <protocol>. N is displayed in the syringe manufacturer field. To delete the protocol press ▲ or ▼ to change the N to Y and press CONFIRM. The pump displays UPDATING.

NOTE

To skip deletion, confirm a N response. The pump returns to the ▲ ▼ SELECT PROTOCOL prompt.

CAUTION

To prevent corruption of the configuration data, do not turn off the pump while UPDATING is being displayed.

8.4.1.2.4 MODIFY LIBRARY

The MODIFY LIBRARY function allows the operator to rename, enable or disable a protocol library.

Immediately after the MODIFY LIBRARY function is selected, the pump displays ENABLE NONE LIBRARY OPTION with a Y or N response, indicating respectively that the option is currently enabled or disabled. Enabling this option adds a NONE selection to the list of available libraries, allowing protocol selection to be bypassed during normal programming. Press ▲ or ▼ if necessary to change the response and press CONFIRM to complete this step.

At the ▲ ▼ SELECT LIBRARY prompt, press ▲ or ▼ as necessary to select the library to be modified, and press CONFIRM to complete the selection.

Once a library has been selected, the pump displays NAME <library-name> where <library-name> is the name of the selected library. Press CONFIRM to accept the current library name, or change the name to any name that is not already assigned to another library. Press CONFIRM to complete the library name entry.

Next, the pump displays ENABLE NONE PROTOCOL OPTION with a Y or N response, indicating respectively that the option is currently enabled or disabled. Enabling this option adds a NONE selection to the list of available protocols in the library, allowing protocol selection to be bypassed during normal programming. Press ▲ or ▼ if necessary to change the response and press CONFIRM to complete this step.

Next, the pump displays ENABLE <library name> with a Y or N response, indicating respectively that library is currently enabled or disabled. Only the names of enabled libraries are displayed at the SELECT LIBRARY programming step. Press ▲ or ▼ as necessary to change the response and press CONFIRM to complete this step. The pump displays UPDATING.

CAUTION

To prevent corruption of the configuration data, do not turn off the pump while UPDATING is being displayed.

8.4.1.2.5 DELETE LIBRARY

The DELETE LIBRARY function allows the operator to delete a protocol library. The library to be deleted must be empty, that is, any protocols in the library must first have been deleted.

If the pump displays ▲ ▼ SELECT LIBRARY, press ▲ or ▼ as necessary to select the library to be deleted, and press CONFIRM to complete the selection.

The pump prompts the operator to confirm the deletion by displaying DELETE <library-name>. N is displayed in the syringe manufacturer field. To delete the protocol press ▲ or ▼ to change the N to Y and press CONFIRM. The pump displays UPDATING.

NOTE

To skip deletion, confirm a N response. The pump returns to the ▲ ▼ SELECT LIBRARY prompt.

CAUTION

To prevent corruption of the configuration data, do not turn off the pump while UPDATING is being displayed.

8.4.1.2.6 CREATE PROTOCOL

The CREATE PROTOCOL function allows the operator to add a new protocol to a protocol library.

If the pump displays ▲ ▼ SELECT LIBRARY, press ▲ or ▼ as necessary to select the library to which the protocol is to be added, and press CONFIRM to complete the selection.

Once a protocol has been selected, the pump displays NAME. Line 2 of the text display is blank. Enter a name that is not already assigned to another protocol within the same library. Press CONFIRM to complete the protocol name entry.

Next, the pump displays SELECT MODE ▲ ▼. Press ▲ or ▼ to select an infusion mode to be assigned to the protocol, and press CONFIRM to complete mode selection.

NOTES

The pump offers an ALL MODES selection. If this selection is chosen, all infusion modes will be available when the protocol is selected during normal programming.

If ALL MODES, SINGLE DOSE, MANUAL SCHEDULE, AUTO SCHEDULE or CUSTOM DILUTION is selected when CONFIRM is pressed, no further settings are allowed for the protocol. If any

changes were made to the protocol, the pump displays UPDATING immediately.

The mode assigned to a protocol will be available when that protocol is selected during normal programming, even if the mode is not enabled in the MODES configuration group.

CAUTION

To prevent corruption of the configuration data, do not turn off the pump while UPDATING is being displayed.

If a mode other than ALL MODES, SINGLE DOSE, MANUAL SCHEDULE, AUTO SCHEDULE or CUSTOM DILUTION is assigned to the protocol, the pump displays additional prompts for any of the following that apply to the mode selected:

- Concentration
- Dose or Rate

At each prompt dashes are displayed indicating that no default value is defined. Use the digits (0-9) and the decimal point (.) as necessary to enter a default value or leave dashes displayed if no default value is required. Press CONFIRM to complete each entry.

Next, the pump displays ALLOW BOLUS with a Y response, indicating that bolus delivery is currently allowed by the protocol. Press ▲ or ▼ if necessary to change the response and press CONFIRM to complete this step.

Next, the pump displays a BOLUS SIZE prompt. Dashes are displayed indicating that no default value is defined. Use the digits (0-9) and the decimal point (.) as necessary to enter a default value or leave dashes displayed if no default value is required. Press CONFIRM to complete the entry.

Next, the pump displays a BOLUS MAX RATE prompt for entry of a bolus delivery rate limit. The units for bolus max rate are the same as the dose units (for example, mcg/min for MCG/MIN mode, mL/hr for ML/HR mode, and so forth). Dashes are displayed indicating that no default value is defined. Use the digits (0-9) and the decimal point (.) as necessary to enter a default value or leave dashes displayed if no default value is required. Press CONFIRM to complete the entry.

When all default settings have been confirmed, the pump displays UPDATING.

CAUTION

To prevent corruption of the configuration data, do not turn off the pump while UPDATING is being displayed.

8.4.1.2.7 CREATE LIBRARY

The CREATE LIBRARY function allows the operator to create a new, empty protocol library.

The pump displays NAME. Line 2 of the text display is blank. Enter a name that is not already assigned to another library. Press CONFIRM to complete the library name entry.

Next, the pump displays ENABLE NONE LIBRARY OPTION with a Y response, indicating that the option is currently enabled. Enabling this option adds a NONE selection to the list of available libraries, allowing protocol selection to be bypassed during normal programming. Press ▲ or ▼ if necessary to change the response and press CONFIRM to complete this step. The pump displays UPDATING.

NOTE

All newly created libraries are enabled (available for selection at programming time). A library may be disabled with the MODIFY LIBRARY function.

CAUTION

To prevent corruption of the configuration data, do not turn off the pump while UPDATING is being displayed.

8.4.1.2.8 CHANGE CODE

The CHANGE CODE function allows the operator to change the library access code to any other four digit number. The pump will subsequently allow access to the protocol library editing mode only by use of the new library access code.

The pump displays <code> CODE where <code> is the current library access code. Press CONFIRM to accept the current code, or enter a new code and press CONFIRM.

At the ENTER AGAIN prompt reenter the code from the previous step and press CONFIRM. The pump displays UPDATING.

CAUTION

To prevent corruption of the configuration data, do not turn off the pump while UPDATING is being displayed.

8.4.1.2.9 RECEIVE

The RECEIVE function allows an operator to copy the entire configuration file including protocol libraries and library access code from one pump directly to a second pump, thus

permitting replication of configuration information from a master pump to multiple receiving pumps.

Refer to Chapter 9, CONFIGURATION REPLICATION.

8.4.2 MODES Group

The MODES configuration group allows the operator to individually enable and disable each of the 18 infusion modes. Only enabled modes are displayed at the SELECT MODES programming step. To select the MODES group confirm a Y response to the CONFIG MODES prompt.

Each of the eighteen infusion modes is indicated by its normal Standby state Mode Selection display. Each mode display includes a Y or N response indicating respectively that the mode is currently enabled or disabled. For each infusion mode, press ▲ or ▼ if necessary to change the response and press CONFIRM to complete the setting. At least one mode must be enabled. When CONFIRM is pressed for the last mode display, the pump displays UPDATING.

CAUTION

To prevent corruption of the configuration data, do not turn off the pump while UPDATING is being displayed.

8.4.3 SYRINGES Group

The SYRINGES configuration group allows the operator to individually enable and disable each of the three syringe manufacturers. To select the SYRINGES group confirm a Y response to the CONFIG SYRINGES prompt.

The SYRINGES group presents a series of syringe manufacturer displays:

1. ENABLE B-D = Becton Dickinson®
2. ENABLE MONOJECT = Monoject®
3. ENABLE TERUMO = Terumo®

Each syringe manufacturer display includes a Y or N response, indicating respectively that the manufacturer is currently enabled or disabled. Only enabled manufacturers are displayed at the SELECT MFR programming step. For each manufacturer, press ▲ or ▼ if necessary to change the response and press CONFIRM to complete the setting. At least one syringe manufacturer must be enabled. If a N response is confirmed at a syringe manufacturer display, the pump proceeds to the next manufacturer display.

If a Y response is confirmed at a syringe manufacturer display, the pump displays a SELECT SYRINGES prompt with a response of Y. Press CONFIRM to enable or disable

individual syringe selections, or press ▲ or ▼ to change the response to N and press CONFIRM to continue with the next manufacturer display.

If a Y response is confirmed at the SELECT SYRINGES prompt, the pump displays a series of syringe size selections. Each selection is presented with a Y or N response, indicating respectively that syringe is currently enabled or disabled. Only enabled syringes are displayed at the SELECT SIZE programming step and only enabled syringes are recognized by Syringe Recognition. For each selection, press ▲ or ▼ if necessary to change the response and press CONFIRM to complete the setting. At least one syringe size must be enabled for each enabled manufacturer.

When CONFIRM is pressed for the last syringe size selection, the pump presents the next manufacturer display. When all manufacturers have been displayed the pump displays UPDATING.

CAUTION

To prevent corruption of the configuration data, do not turn off the pump while UPDATING is being displayed.

8.4.4 DEFAULTS Group

DEFAULTS group options affect the way the pump initializes certain programming selections when ▲ or ▼ is pressed. To select the DEFAULTS group confirm a Y response to the CONFIG DEFAULTS prompt.

The text field displays the following DEFAULTS configuration group options. Each option allows one of two possible responses: Y or N. For each option, press ▲ or ▼ if necessary to change the response and press CONFIRM to complete the setting.

- DFAULT LIBRARY
- DFAULT PROTOCOL
- DFAULT MODE
- DFAULT MFR

8.4.4.1 DFAULT LIBRARY

The DFAULT LIBRARY option determines the response of the pump to the first arrow key press following the ▲ ▼ SELECT LIBRARY programming prompt.

Y The pump displays the name of the last used protocol library selection.

N The pump displays NONE if the NONE protocol library selection option is enabled else it displays the first protocol library selection in the alphabetical sequence.

8.4.4.2 DFAULT PROTOCOL

The DFAULT PROTOCOL option determines the response of the pump to the first arrow key press following the ▲ ▼ SELECT PROTOCOL programming prompt.

Y The pump displays the name of the last used protocol selection if the last used library is selected, else it displays the first protocol selection (in the alphabetical sequence) in the selected library.

N The pump displays NONE if the NONE protocol selection option is enabled, else it displays the first protocol selection (in the alphabetical sequence) in the selected library.

8.4.4.3 DFAULT MODE

The DFAULT MODE option determines the response of the pump to the first arrow key press following the SELECT MODE ▲ ▼ programming prompt.

Y The pump presents the mode display for the last used mode if no protocol has been selected or a protocol with ALL MODES has been selected.

N The pump presents the mode display for the first enabled mode selection if no protocol has been selected or a protocol with ALL MODES has been selected.

8.4.4.4 DFAULT MFR

The DFAULT MFR option determines the response of the pump to the first arrow key press following the SELECT MFR ▲ ▼ programming prompt.

Y The pump presents the syringe manufacturer display for the last used syringe manufacturer if it is enabled, else it presents the syringe manufacturer display for the first enabled syringe manufacturer.

N The pump presents the syringe manufacturer display for the first enabled syringe manufacturer.

8.4.5 MISC Group

The MISC (miscellaneous) group displays the following options:

- REMOTE CONTROL
- LIBRARY
- SIZE OVERRIDE
- PSI RANGE
- AUDIO RANGE
- RATE RANGE
- AUTO LOCK

- BACKLITE
- ENABLE DB9 PORT

To select the MISC group, confirm a Y response to the CONFIG MISC prompt. Unless otherwise instructed, for each option or prompt press ▲ or ▼ if necessary to change the response and press CONFIRM to complete the setting.

8.4.5.1 REMOTE CONTROL

The REMOTE CONTROL option determines whether remote control operation is allowed. This option allows one of two possible responses: Y or N.

Y Remote control operation may be enabled and activated.

N Remote control operation is not allowed.

8.4.5.2 LIBRARY

The LIBRARY option determines whether the Protocol Library feature is enabled. This option allows one of two possible responses: Y or N.

Y The Protocol Library feature is enabled.

N The Protocol Library feature is disabled.

8.4.5.3 SIZE OVERRIDE

The SIZE OVERRIDE option allows the operator to:

- Override syringe recognition by using the arrow keys to select a syringe size other than the size displayed by the pump.
- Override a SIZE MISMATCH alert by using CONFIRM.

This option allows one of two possible responses: Y or N.

Y The SIZE OVERRIDE feature is enabled.

N The SIZE OVERRIDE feature is disabled.

8.4.5.4 PSI RANGE

The PSI RANGE option determines the occlusion pressure threshold. This option allows one of three possible responses: L (low), M (medium) or H (high), which enable specific fixed alarm threshold points.

Anticipated nominal occlusion pressures in PSI are:

Syringe Size	Configuration Setting L	M	H
60	8	13	17
30,35	8	14	19
20	9	15	20
10,12	10	15	21
5,6	12	17	24
3	14	20	27
1	19	27	27

8.4.5.5 AUDIO RANGE

The AUDIO RANGE option determines the audio circuit output level. This option allows one of two possible responses: L (low) or H (high).

8.4.5.6 RATE RANGE

The RATE RANGE option determines the maximum infusion rate. This option allows one of three possible responses:

L (low) maximum rate = 15mL /hr (0.25 mL/min)
M (medium) maximum rate = 120 mL/hr (2 mL/min)
H (high) maximum rate = approximately 366 mL/hr or 6.1 mL/min for a B-D® 60 mL Plastic syringe

8.4.5.7 AUTO LOCK

The AUTO LOCK option determines whether the Auto Lock feature is enabled. This option allows one of two possible responses: Y or N.

Y The Auto Lock feature is enabled.

N The Auto Lock feature is disabled.

8.4.5.8 SET BACKLITE

The SET BACKLITE option allows the operator to determine the operation of the backlight when pump power is on and the charger is not connected.

The pump displays SET BACKLITE with a N response. Press CONFIRM to skip to the next option or press ▲ or ▼ to change the response to Y and press CONFIRM to access the backlight setting.

If Y is selected, the pump displays a <xx> MINUTES prompt where <xx> is the current setting. When the charger is not connected, the pump turns on the backlight for the configured time, following any key press. The timer is restarted at each subsequent key press. Press CONFIRM to accept the current setting or enter a new value of 0 to 60 minutes and press CONFIRM to complete the setting.

NOTES

If the pump goes into a Low Battery condition, the backlight 'on' time is temporarily reduced to a maximum of 2 minutes for each key press.

If 0 minutes is configured, the backlight is not activated unless the charger is connected.

If the charger is connected, the backlight is kept on during the entire POST, but is turned off for 1/2 second at the start of the first programming prompt.

8.4.5.9 ENABLE DB9 PORT

The ENABLE DB9 PORT option determines whether the DB9 port or the mini-DIN port will be used as the serial I/O port. This option allows one of two possible responses: Y or N.

Y The DB9 port will be used as the serial I/O port.

N The mini-DIN port will be used as the serial I/O port.

NOTE

Replication cables for use with the DB9 port (catalog no. 2M8155) are available. See Chapter 9 for the replication procedure.

8.4.6 ALERTS Group

The ALERTS group includes the following options:

- IDLE ALARM
- SET NEAR END
- BOLUS COMPLETE
- DOSE COMPLETE
- VOLUME LIMIT

To select the ALERTS group confirm a Y response to the CONFIG ALERTS prompt. Unless otherwise instructed, for each option or prompt, press ▲ or ▼ if necessary to change the response and press CONFIRM to complete the setting.

8.4.6.1 IDLE ALARM

The IDLE ALARM option determines whether a PUMP IS IDLE condition will be indicated by an alert or an alarm. This option allows one of two possible selections: Y or N.

Y A PUMP IS IDLE condition will be indicated by an alarm.

N A PUMP IS IDLE condition will be indicated by an alert.

8.4.6.2 SET NEAR END

The SET NEAR END configuration option allows the operator to customize <xxMIN alerts (<xxMIN EMPTY, <xxMIN VOLUME LIMIT, <xxMIN <protocol>).

The pump displays SET NEAR END with a N response. Press CONFIRM to skip to the BOLUS COMPLETE option or press ▲ or ▼ to change the response to Y and press CONFIRM to access the settings.

If Y is selected, the pump displays a <xx> MINUTES prompt where <xx> is the current number of minutes for a <xxMIN alert prior to an EMPTY or VOLUME LIMIT alarm. Press CONFIRM to accept the current setting or enter a new value of 5 to 60 minutes and press CONFIRM to complete the setting.

Next, the pump displays a <bb> BEEPS prompt where <bb> is the number of beeps for a <xxMIN alert. Press CONFIRM to accept the current setting or enter a new value of 1 to 15 beeps and press CONFIRM to complete the setting.

8.4.6.3 BOLUS COMPLETE

The BOLUS COMPLETE option determines whether the BOLUS COMPLETE alert is enabled. This option allows one of two possible responses: Y or N.

Y Enable the BOLUS COMPLETE alert.

N Disable the BOLUS COMPLETE alert.

8.4.6.4 DOSE COMPLETE

The DOSE COMPLETE option determines whether the DOSE COMPLETE alarm is enabled. This option allows one of two possible responses: Y or N.

Y Enable the DOSE COMPLETE alarm.

N Disable the DOSE COMPLETE alarm.

8.4.6.5 VOLUME LIMIT

The VOLUME LIMIT option determines whether the VOLUME LIMIT alarm is enabled. This option allows one of two possible selections: Y or N.

Y The VOLUME LIMIT alarm is enabled.

N The VOLUME LIMIT alarm is disabled.

8.4.7 CLOCK Group

The CLOCK group allows the operator to set the real-time clock.

To select the CLOCK group confirm a Y response to the CONFIG CLOCK prompt.

The pump displays the time and date in the text field in the following format (typical date and time):

12.00AM
12/13/95

To set the time and/or date, press EDIT as necessary to select the desired field. The time and date fields are accessed in the following sequence: hours, minutes, AM/PM, month, day, year.

Enter new values for hours, minutes, month, day, or year directly from the keypad. Press ▲ or ▼ to toggle the AM/PM field.

Press CONFIRM to complete entry of the combined date and time.

8.4.8 IDENT Group

The IDENT group allows the operator to select an alphanumeric identifier of up to eight characters to be displayed following the Power-on self test (POST).

To select the IDENT group, confirm a Y response to the CONFIG IDENT prompt.

Press CONFIRM to accept the current identifier, or change the identifier as indicated in section 8.5, Entering Text Data. Press CONFIRM to complete the entry.

8.5 ENTERING TEXT DATA

The following rules apply for entering library names, protocol names and the identifier (IDENT) field:

- The current character position is indicated by flashing.
- A flashing underscore ('_') character is used to indicate a blank in the current character position.
- The characters A through Z and '-' are selected by pressing ▲ or ▼.
- The characters 0 through 9 are entered directly from the keypad.
- A blank character can be selected by pressing CLR.
- The next character position is selected by pressing EDIT.

NOTE

Only after identifier changes have been completed should CONFIRM be pressed.

8.6 FACTORY DEFAULT CONFIGURATION

Protocol Libraries								
Library Name	**Drug Name**	**Protocol Name**	**Default Mode**	**Default Conc. (mg/ml)**	**Default Dose**	**Bolus Allowed**	**Max Bolus Rate**	**NONE Protocol Selection Option**
ANALGESC								Yes
	Alfentanil	ALFENTAN	MCG/KG/MIN	0.05	----	No	----	
	Remifentanil	REMIFENT	MCG/KG/MIN	0.05	----	No	----	
	Sufentanil	SUFENTAN	MCG/KG/HR	0.05	----	No	----	
ANES--HYP								Yes
	Propofol	PROPOFOL	MCG/KG/MIN	10	----	No	----	
CARDIO								Yes
	Dobutamine	DOBUTAMI	MCG/KG/MIN	5	----	No	----	
	Dopamine	DOPAMINE	MCG/KG/MIN	3.2	----	No	----	
	Isoproterenol	ISOPROTE	MCG/MIN	0.004	----	No	----	
	Nitroglycerin	NITROGLY	MCG/MIN	0.4	----	No	----	
	Nitroprusside	NITROPRU	MCG/KG/MIN	0.2	----	No	----	
	Norepinephrine	NOREPINE	MCG/MIN	0.004	----	No	----	
MUSRELAX								Yes
	Atracurium	ATRACURI	MCG/KG/MIN	0.5	----	No	----	
	Mivacurium	MIVACURI	MCG/KG/MIN	2	----	No	----	
	Rocuronium	ROCURONI	MG/KG/MIN	10	----	No	----	
	Succinylcholine	SUCCINYL	MG/MIN	2	----	No	----	
	Vecuronium	VECURONI	MCG/KG/MIN	0.2	----	No	----	
NONE Library Selection Option: Enabled								

8.6 FACTORY DEFAULT CONFIGURATION (CONTINUED)

MODES Group	
Option	**Setting**
ML/MIN	N
ML/HR	Y
MUNITS/MIN	N
MUNITS/HR	N
UNITS/MIN	N
UNITS/HR	N
SINGLE DOSE	Y
MANUAL SCHEDULE	N
AUTO SCHEDULE	N
MCG/MIN	Y
MCG/HR	N
MG/MIN	N
MG/HR	N
MCG/KG/MIN	Y
MCG/KG/HR	Y
MG/KG/MIN	N
MG/KG/HR	N
CUSTOM DILUTION	N

SYRINGES Group	
Option	**Setting**
B-D®	Y
1mL SLIP TIP	Y
3 mL	Y
5 mL PLASTIC	Y
10 mL PLASTIC	Y
20 mL	Y
30 mL	Y
60 mL	Y
Monoject®	Y
1 mL Plastic	Y
3 mL Plastic	Y
6 mL Plastic	Y
12 mL Plastic	Y
20 mL Plastic	Y
35 mL Plastic	Y
60 mL Plastic	Y
Terumo®	Y
1 mL Plastic	Y
3 mL Plastic	Y
5 mL Plastic	Y
10 mL Plastic	Y
20 mL Plastic	Y
30 mL Plastic	Y
60 mL Plastic	Y

DEFAULTS Group	
Option	**Setting**
LIBRARY	Y
PROTOCOL	Y
MODE	Y
MFR	Y

MISC Group	
Option	**Setting**
REMOTE CONTROL	N
LIBRARY	N
SIZE OVERRIDE	N
PSI RANGE	M
AUDIO RANGE	H
RATE RANGE	H
AUTO LOCK	N
BACKLITE	2 minutes
ENABLE DB9 PORT	Y

ALERTS Group	
Option	**Setting**
IDLE ALARM	Y
NEAR END	10 minutes 5 beeps
BOLUS COMPLETE	N
DOSE COMPLETE	Y
VOLUME LIMIT	Y

IDENT Group	
Option	**Setting**
	AS50

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9.1 GENERAL

The Configuration Replication feature permits duplication of configuration information between pumps.

The following procedure copies the entire configuration file including protocol libraries and library access code from one pump (the source pump) to a second pump (the destination pump).

9.2 CONFIGURATION REPLICATION PROCEDURE

TOOLS REQUIRED:

Small Phillips® screwdriver
Replication Cable (Baxter® P/N 2M8155)
Pen

9.2.1 Setting up the Source Pump

1. Ensure that the source pump is turned off.

2. Remove the DB9 port's cover and connect the replication cable to this port. Secure the cable with the attached thumbscrews.

3. Turn on the source pump and allow the pump to go through its POST. DO NOT press any keys until told to do so.

4. Press "9805" and allow the pump to go through the Date and Time display as well as the Software Version display.

5. Step through the selections (selecting and confirming **N** for each) until **CONFIG MISC.** Press confirm to accept the **Y** response.

6. Step through the selections without changing any until **ENABLE DB9 PORT.** Set **ENABLE DB9 PORT** to **Y**.

7. Exit the configuration program by stepping through the remainder of the options. Do not change any other settings.

8. Turn off the pump and turn it back on again and allow it to go through its POST. DO NOT press any keys until told to do so.

9. Read steps 9 and 10 completely prior to performing them. After **SELECT LIBRARY** or **SELECT MODE** is displayed, press "9805". Have a pen ready.

10. After the Date and Time display, the S/W Version, Configuration Version and Configuration Checksum are displayed momentarily. Record these numbers in the spaces provided on the Data Sheet at the end of this Chapter. The S/W Version is displayed on line 1. The Configuration Version is displayed on the left side of line 2 and the Configuration Checksum is displayed on the right side of line 2. If you need to review these numbers again, repeat steps 8-10.

11. Turn off the source pump.

12. Verify accuracy of configuration with appropriate clinical personnel prior to proceeding.

9.2.2 Setting up the Destination Pump

1. Ensure that the destination pump is turned off.

2. Remove the DB9 port's cover and connect the other end of the replication cable to this port. Secure the cable with the attached thumbscrews.

3. Turn on the destination pump and allow the pump to go through its POST. DO NOT press any keys until told to do so.

4. After **SELECT LIBRARY** or **SELECT MODE** is displayed, press "9805". There will be a momentary Date and Time display and a momentary S/W Version display.

5. When the **CONFIG LIBRARY** prompt appears on the display, press confirm to accept the **Y** response.

6. At the **ENTER CODE** prompt, enter the library access code.

7. At the **SELECT FUNCTION** prompt, press ▼ until **RECEIVE** is displayed.

8. Press **CONFIRM**. The pump will display **PRESS START TO RECEIVE OR CLR TO QUIT**. DO NOT press any key until told to do so.

9.2.3 Replication Procedure

1. Turn on the source pump. DO NOT press any key on the source pump. If a key is inadvertently pressed, turn off the source pump and repeat this step.

2. After the source pump displays **SELECT LIBRARY**, press **START** on the destination pump.

3. The destination pump will display **UPDATING**, while the source pump is displaying **SENDING.**

NOTE

If the **LOCK** key is pressed on the source pump while sending, the replication will be interrupted. This will cause a **COMM FAULT** in the destination pump.

4. When configuration replication is complete (approx. 2 minutes), the destination pump will display **UPDATE FINISHED**.

5. Turn off the source pump.

6. Press **CONFIRM** on the destination pump.

7. Read steps 7 and 8 completely prior to performing them. After the destination pump displays **SELECT LIBRARY**, press "123" (Configuration Review Mode). Have a pen ready.

8. After the Date and Time display, the S/W Version, Configuration Version and Configuration Checksum are displayed momentarily. Record these numbers in the spaces provided on the Data Sheet at the end of this Chapter. The S/W Version is displayed on line 1. The Configuration Version is displayed on the left side of line 2 and the Configuration Checksum is displayed on the right side of line 2. If you need to review these numbers again, turn the pump off, turn the pump back on and repeat steps 7 and 8.

9. Confirm that the Checksum of the destination pump matches that of the source pump. This confirms a successful replication.

10. Exit from the configuration review mode. Turn the destination pump off.

11. Disconnect the replication cable from both pumps and replace the DB9 covers.

NOTES

The library access code in the destination pump will now be the same as the source pump. Also, the destination pump will now have the DB9 port enabled. It may be desirable to alter these two settings.

The date and time settings on the source pump are copied to the destination pump.

9.2.4 Error Recovery

If the destination pump alarms because replication was interrupted, perform the following procedure.

1. Turn off both pumps.

2. Turn on the destination pump. Following the POST, the pump will issue a **CONFIG CORRUPT** alarm.

3. Press "9805." The pump will present a modified Software Version display. The modified Software Version display will indicate the Software Version and the first character of the Configuration Version, followed by a dash (for example, [**A-**]). The Configuration Checksum will not be displayed.

4. At the **ENTER CODE** prompt, enter the library access code (the default factory access code is 0000). Press **CONFIRM**.

5. The destination pump will automatically select the **RECEIVE** function and display **PRESS START TO RECEIVE OR CLR TO QUIT**. DO NOT press any key until told to do so.

6. Continue at step 1 of the **REPLICATION** procedure.

9.3 REPLICATION DATA SHEET

SOURCE PUMP			DESTINATION PUMP		
S/W Version	Conf. Version	Conf. Checksum	S/W Version	Conf. Version	Conf. Checksum

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10.1 GENERAL

This chapter contains detailed descriptions of alert and alarm conditions not listed in the pump Operator's Manual.

10.2 ALERTS

10.2.1 Cal Invalid

Cause:	invalid calibration reading
Audio response:	single beep
LED response:	none
Message duration:	2 seconds

1. Issued during any calibration if the second reading taken is not smaller than the first, or if either calibration measurement is grossly out of range. Following the alert the pump restarts the calibration sequence.

2. Issued at the completion of pressure sensor calibration if the force equivalent of the maximum A/D reading (1023) is not at least 18 pounds. Following the alert the pump restarts the calibration sequence.

10.2.2 Code Mismatch

Cause:	invalid library access code entered
Audio response:	single beep
LED response:	none
Message duration:	2 seconds

1. Issued if an invalid library access code is entered following the **ENTER CODE** prompt at the start of protocol library editing. Following the alert the pump redisplays **ENTER CODE**.

2. Issued during the CHANGE CODE function when the new LIBRARY group access code is entered for the second time and the second code entry does not match the first. Following the alert the pump redisplays the **<code> CODE** prompt.

10.2.3 Date Invalid

Cause:	realtime clock requires manual setting
Audio response:	single beep
LED response:	none
Message duration:	2 seconds

Issued following the lamp test portion of the power-on self test (POST), if the realtime clock has been reset due to a power interruption, such as disconnection of the battery or a CHARGE DEPLETED condition. The alert is issued each time the pump is powered up until the date and time are manually reentered.

10.2.4 Empty Library

Cause:	selected protocol library is empty
Audio response:	single beep
LED response:	none
Message duration:	2 seconds

Issued during MODIFY PROTOCOL or DELETE PROTOCOL, if the selected library is empty.

10.2.5 Exists Already

Cause:	duplicate protocol or library name entered
Audio response:	single beep
LED response:	none
Message duration:	2 seconds

Issued during the MODIFY PROTOCOL, CREATE PROTOCOL, MODIFY LIBRARY or CREATE LIBRARY function if the library or protocol name entered is not unique. Following the alert the pump restores the text field and editing cursor.

10.2.6 Memory Full

Cause:	no space in EEPROM to add new protocol
Audio response:	single beep
LED response:	none
Message duration:	2 seconds

Issued if all protocol slots are filled when the CREATE PROTOCOL function is selected or if all library slots are filled when the CREATE LIBRARY function is selected. Following the alert, the pump returns to the ▲▼ SELECT FUNCTION prompt.

A maximum of ten named libraries and a maximum of 70 protocols (total) are allowed.

10.2.7 Name Invalid

Cause:	"NONE" or all blanks entered for library or protocol name
Audio response:	single beep
LED response:	none
Message duration:	2 seconds

Issued during the MODIFY PROTOCOL, CREATE PROTOCOL, MODIFY LIBRARY or CREATE LIBRARY function if all blanks or "NONE" is entered as the protocol name. Following the alert the pump restores the text field and editing cursor.

10.2.8 No Library

Cause:	selected function invalid because no library exists
Audio response:	single beep
LED response:	none
Message duration:	2 seconds

Issued if the MODIFY PROTOCOL, DELETE PROTOCOL, MODIFY LIBRARY, DELETE LIBRARY, CREATE PROTOCOL or VIEW LIBRARY function is selected and no library has been created.

Following the alert the pump returns to the ▲▼ SELECT FUNCTION prompt.

10.2.9 Not Empty

Cause:	attempt to delete non-empty library
Audio response:	single beep
LED response:	none
Message duration:	2 seconds

Issued during the DELETE LIBRARY function if the selected (or only) library is not empty.

Following the alert the pump returns to the ▲▼ SELECT LIBRARY prompt.

10.3 ALARMS

10.3.1 Cal Sensors

Cause:	The pump's calibration data has been corrupted. Indicates a malfunctioning digital PCB.
Audio response:	single beep
LED response:	none
Message duration:	until **<5089>** code is entered

Issued if the pump detects, during the POST, that any of the four sensor functions has not been calibrated.

The operator is allowed to enter Calibration Mode by pressing the key sequence 5,0,8,9, but *no other operation is allowed until all four sensor functions have been recalibrated.*

Once the pump is in Calibration Mode, only the **Y** response is allowed at the **CAL DRIVEPOS**, **CAL SYRNGREC** and **CAL PRESSENS** prompts.

10.3.2 Charge Depleted

Cause:	battery voltage below minimum
Audio response:	continuous beeps
LED response:	**ALERT** LED flashes while message is displayed; **BATTERY** LED on continuously
Message duration:	until <**5089**> is entered or power is cycled

Issued following the POST if the pump detects that the battery voltage has fallen below 5.5 V at power up.

Any keypress will terminate the audio portion of the alarm. The pump will respond to all keypresses with an error beep. The pump will allow the operator to access VB_SENSE calibration directly by pressing 5,0,8,9.

10.3.3 Comm Fault

Cause:	unrecoverable transmission error during configuration replication
Audio response:	continuous beeps
LED response:	ALERT LED flashes while message is displayed
Message duration:	until **<5089>** code is entered

Issued during configuration replication if the destination pump detects an unrecoverable transmission error. The pump drops out of replication.

If the alarm occurs before any data is received, it may be cleared by pressing any key. The pump returns to the **SELECT FUNCTION** prompt, and the RECEIVE function may be selected again.

If the alarm occurs while configuration replication is in progress, a keypress will silence the audio portion of the alarm only. The text message and ALERT LED persist, and the only recovery is to cycle power. Further, the destination pump will display **CONFIG CORRUPT** following the next power up. A valid configuration must be loaded into the pump before it may be operated normally.

10.3.4 Comm Timeout

Cause:	interrupted data flow during configuration replication
Audio response:	continuous beeps
LED response:	ALERT LED flashes while message is displayed
Message duration:	until **<5089>** code is entered

Issued during configuration replication if the destination pump detects an interruption in data flow for more than 5 seconds. The pump drops out of replication.

If the alarm occurs before any data is received, it may be cleared by pressing any key. The pump returns to the **SELECT FUNCTION** prompt, and the RECEIVE function may be selected again.

If the alarm occurs while configuration replication is in progress, a keypress will silence the audio portion of the alarm only. The text message and ALERT LED persist, and the only recovery is to cycle power. Further, the destination pump will display **CONFIG CORRUPT** following the next power up. A valid configuration must be loaded into the pump before it may be operated normally.

10.3.5 Config Corrupt

Cause:	library or configuration data corrupted
Audio response:	single beep
LED response:	none
Message duration:	until **<9805>** is entered or power is cycled

Issued following the power-on self test (POST) if the pump detects during the POST that library or configuration data is corrupted. Pressing the key sequence 9,8,0,5 is the only valid operator action.

Also issued if the pump detects corrupted data during protocol selection. In this instance, the pump will not respond to any further operator action, and will issue a CONFIG CORRUPT error following the POST on the next power up.

A CONFIG CORRUPT alarm condition requires one of two remedies: replication of a complete valid configuration from another pump, or downloading a configuration via the DB9 port.

If the key sequence 9,8,0,5 is pressed in response to a CONFIG CORRUPT alarm following the POST, the pump assumes that the operator wishes to perform a replication. The pump first presents a modified software version display. The modified software version display indicates the software version and the first character of the configuration structure descriptor, followed by a dash (for example, **[A-]**). The configuration crc is not displayed.

Next, the pump checks the integrity of the Library Index. If the Library Index data is valid, the operator must enter the library access code. If the operator fails to enter the code correctly in three tries the pump restarts the power-up sequence. The pump then automatically selects the RECEIVE function and displays **PRESS START TO RECEIVE OR CLR TO QUIT**. If CLR is pressed, the pump restarts the power-up sequence.

If the Library Index data appears to be corrupt, the pump skips the **ENTER CODE** prompt and displays **PRESS START TO RECEIVE OR CLR TO QUIT**. If CLR is pressed, the pump restarts the power-up sequence.

10.3.6 Config Mismatch

Cause:	configuration type code / software revision mismatch
Audio response:	single beep
LED response:	none
Message duration:	until **<9805>** is entered or power is cycled

Issued following the power-on self test (POST) if the pump determines (based on the configuration type code) that the configuration structure is incompatible with the current software version.

A CONFIG MISMATCH alarm condition requires one of two remedies: replication of a compatible configuration from another pump, or downloading a compatible configuration via the DB9 port.

If the key sequence 9,8,0,5 is pressed in response to a CONFIG CORRUPT alarm following the POST, the pump assumes that the operator wishes to perform a replication. The pump first presents a modified software version display. The modified software version display indicates the software version and the first character of the configuration structure descriptor, followed by a dash (for example, **[A-]**). The configuration crc is not displayed.

Next, the pump checks the integrity of the Library Index. If the Library Index data is valid, the operator must enter the library access code. If the operator fails to enter the code correctly in three tries, the pump restarts the power-up sequence. The pump then

automatically selects the RECEIVE function and displays **PRESS START TO RECEIVE OR CLR TO QUIT**. If CLR is pressed, the pump restarts the power-up sequence.

If the Library Index data appears to be corrupt, the pump skips the **ENTER CODE** prompt and displays **PRESS START TO RECEIVE OR CLR TO QUIT.** If CLR is pressed, the pump restarts the power-up sequence.

10.3.7 Fuse Failure

Cause:	battery fuse failure
Audio response:	continuous beeps
LED response:	**ALERT** LED flashes while message is displayed; **BATTERY** LED on continuously
Message duration:	until <**5089**> is entered or power is cycled

Issued following the POST if the pump detects a fuse failure at power up.

Any keypress will terminate the audio portion of the alarm. The pump will respond to all keypresses with an error beep. The pump will allow the operator to access VB_SENSE calibration directly by pressing 5,0,8,9.

10.3.8 Power Fault

Cause:	excess supply voltage
Audio response:	continuous beeps
LED response:	**ALERT** LED flashes while message is displayed; **BATTERY** LED on continuously
Message duration:	until <**5089**> is entered or power is cycled

Issued following the POST if the pump detects an over-voltage condition at power up.

Any keypress will terminate the audio portion of the alarm. The pump will respond to all keypresses with an error beep. The pump will allow the operator to access VB_SENSE calibration directly by pressing 5,0,8,9.

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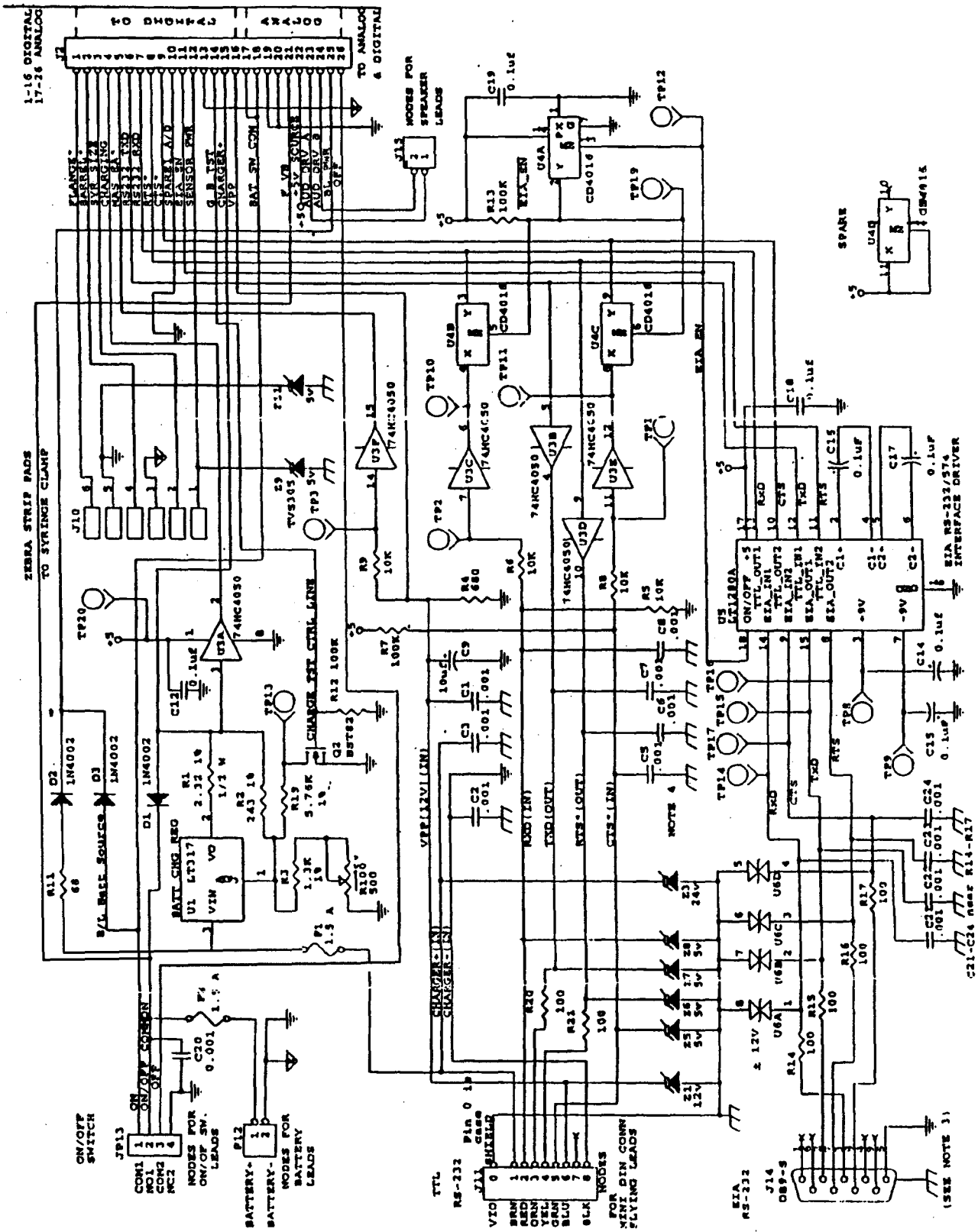
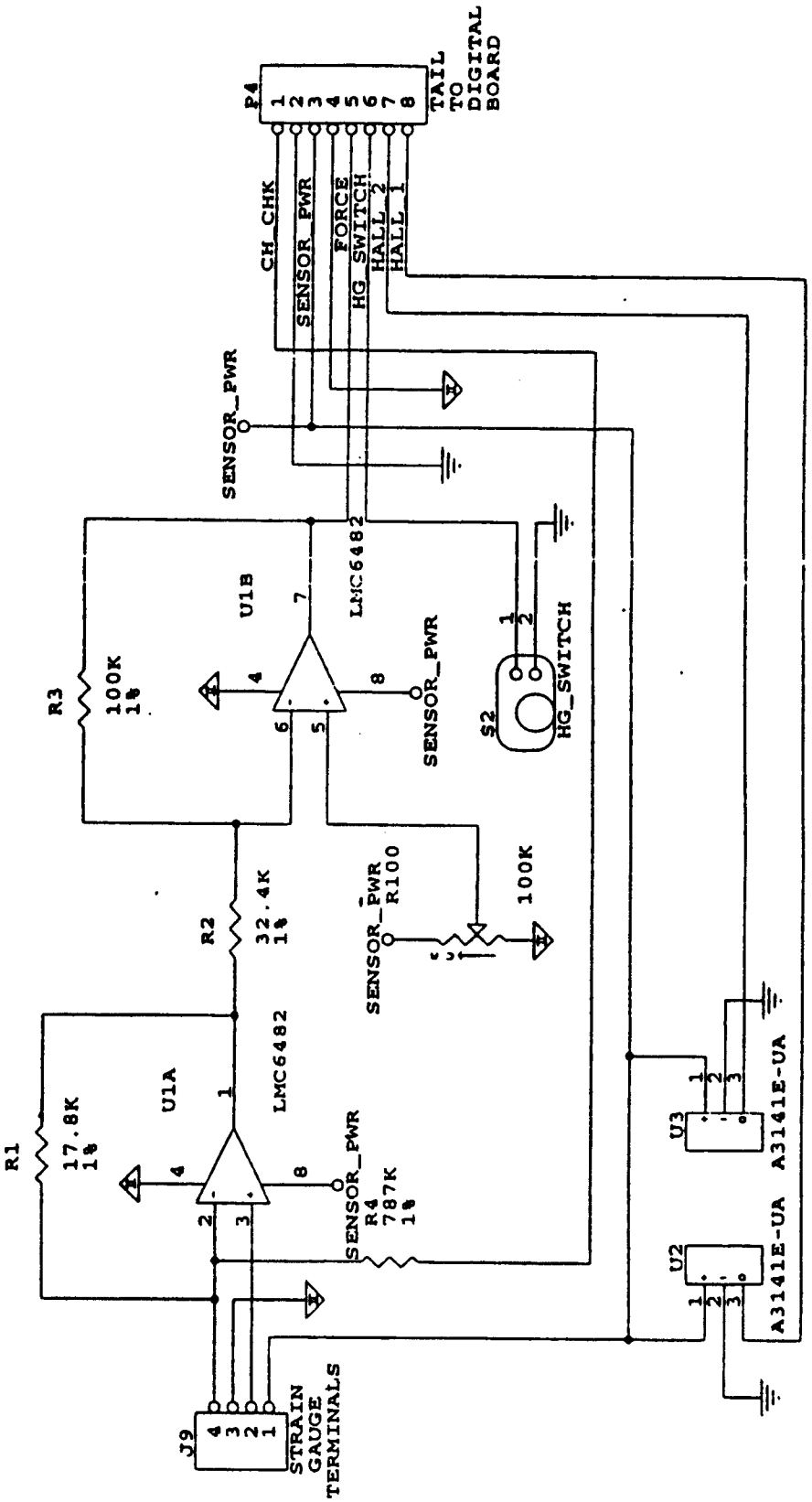
A.1 GENERAL

This appendix contains all of the schematic and wiring diagrams for the pump. A table of contents for this section is shown below:

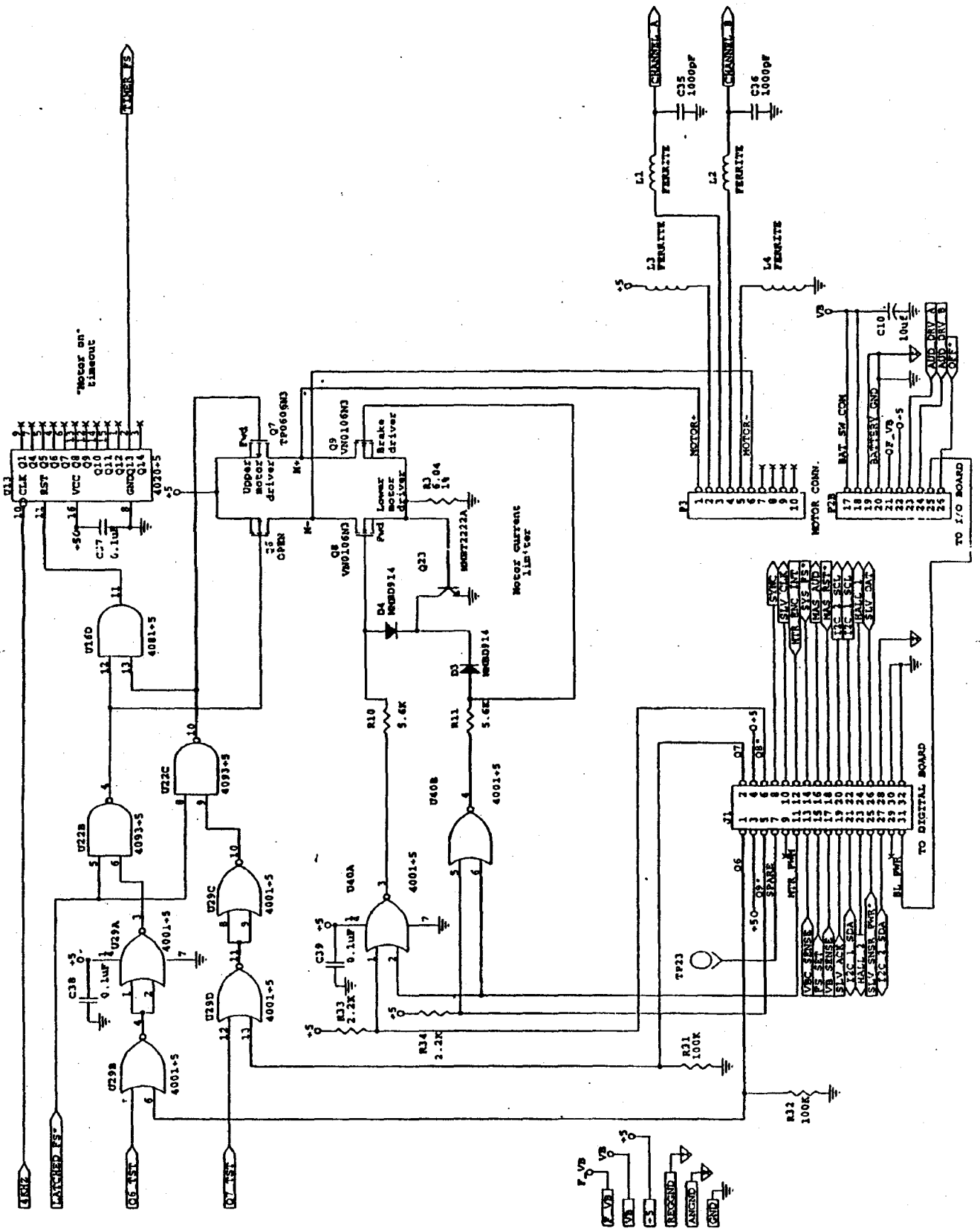
DRAWING NUMBER	DESCRIPTION
D-AS50-01-350	SCHEMATIC, AS50 PUMP, I/O BOARD (1 sheet)
C-AS50-01-351	SCHEMATIC, AS50 PUMP, STRAIN GAUGE BOARD (1 sheet)
D-AS50-01-352	SCHEMATIC, AS50 PUMP, ANALOG BOARD (4 sheets)
D-AS50-01-353	SCHEMATIC, AS50 PUMP, DIGITAL BOARD (5 sheets)



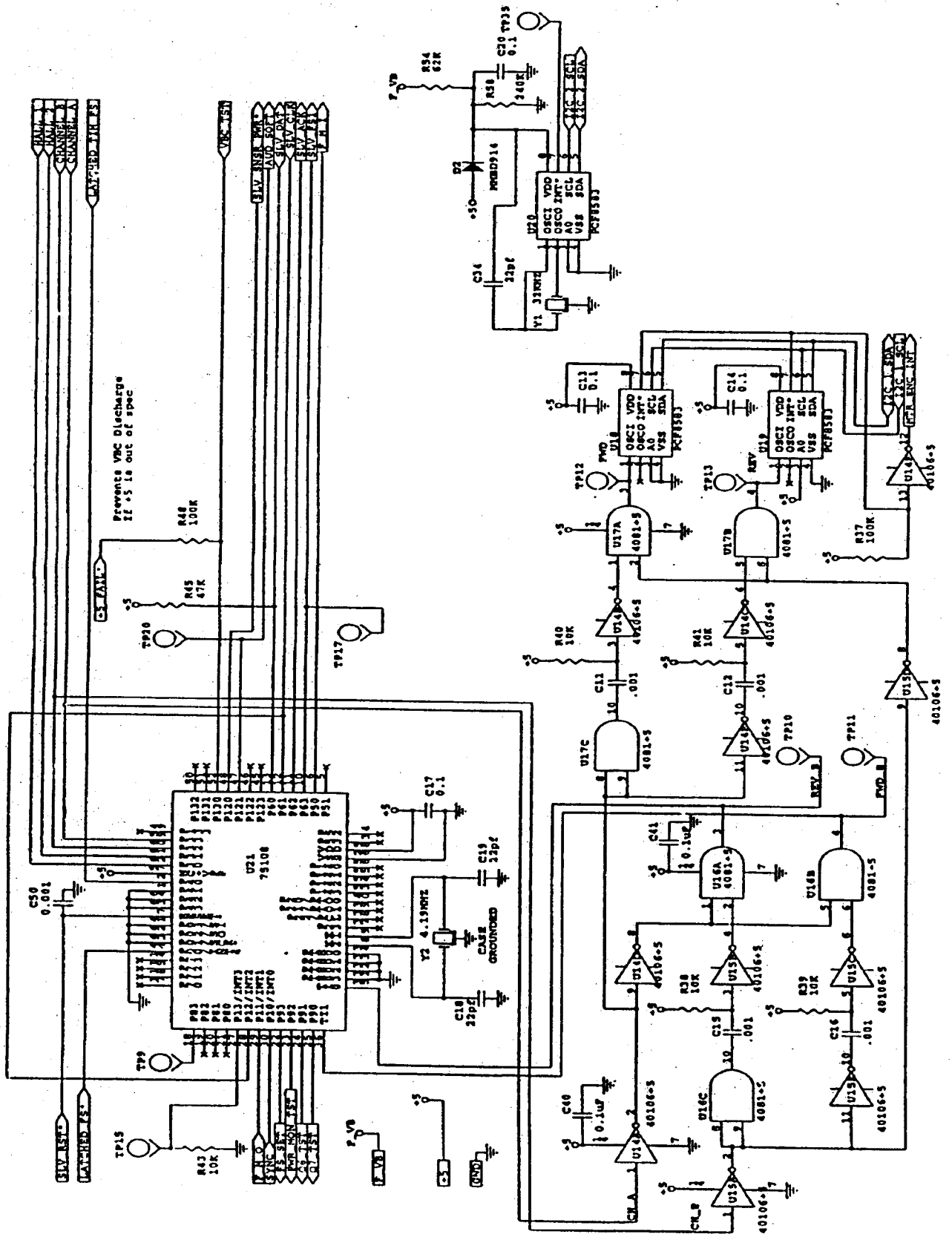
I/O PCB SCHEMATIC D-AS50-01-350



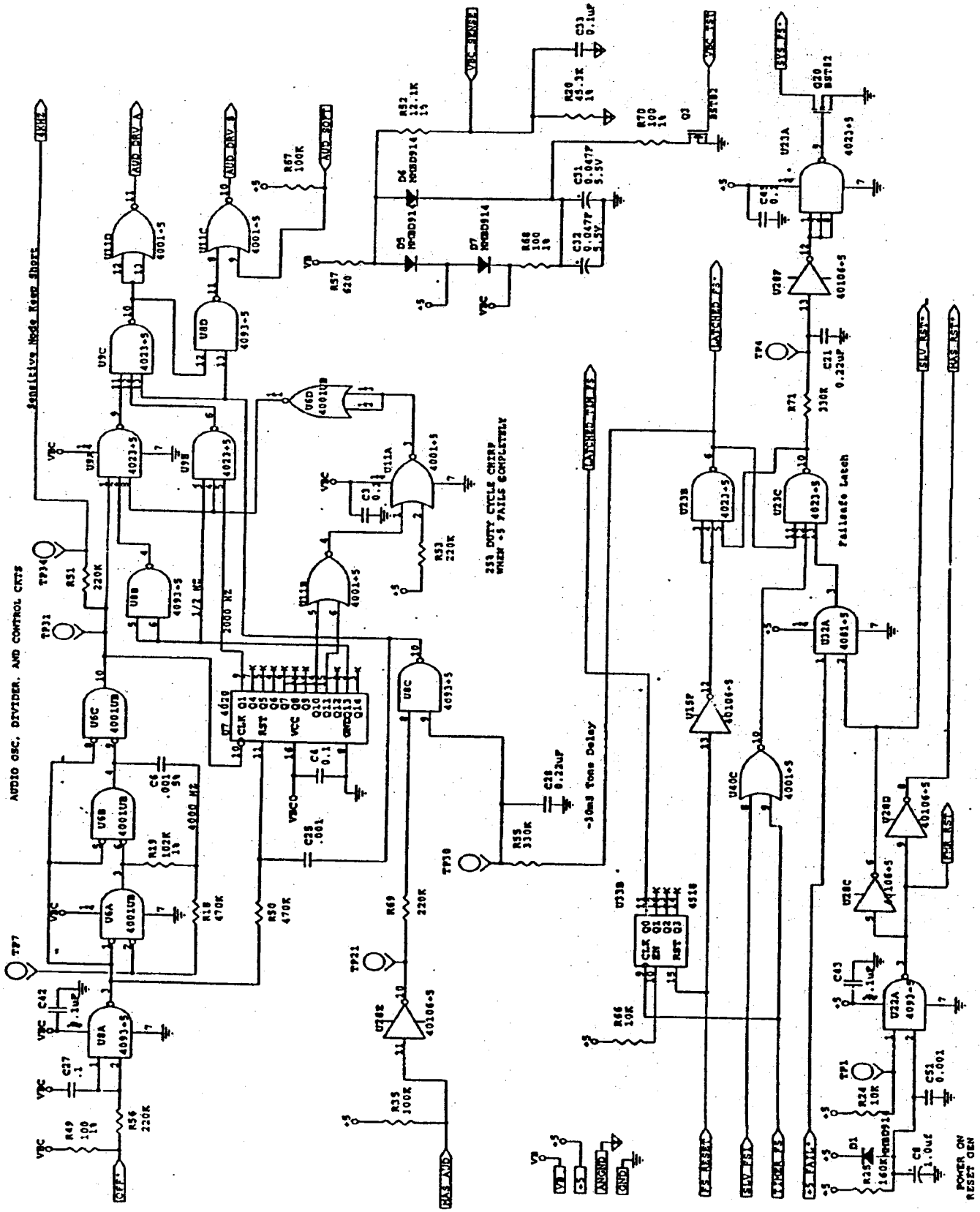
STRAIN GAUGE PCB SCHEMATIC D-AS50-01-351



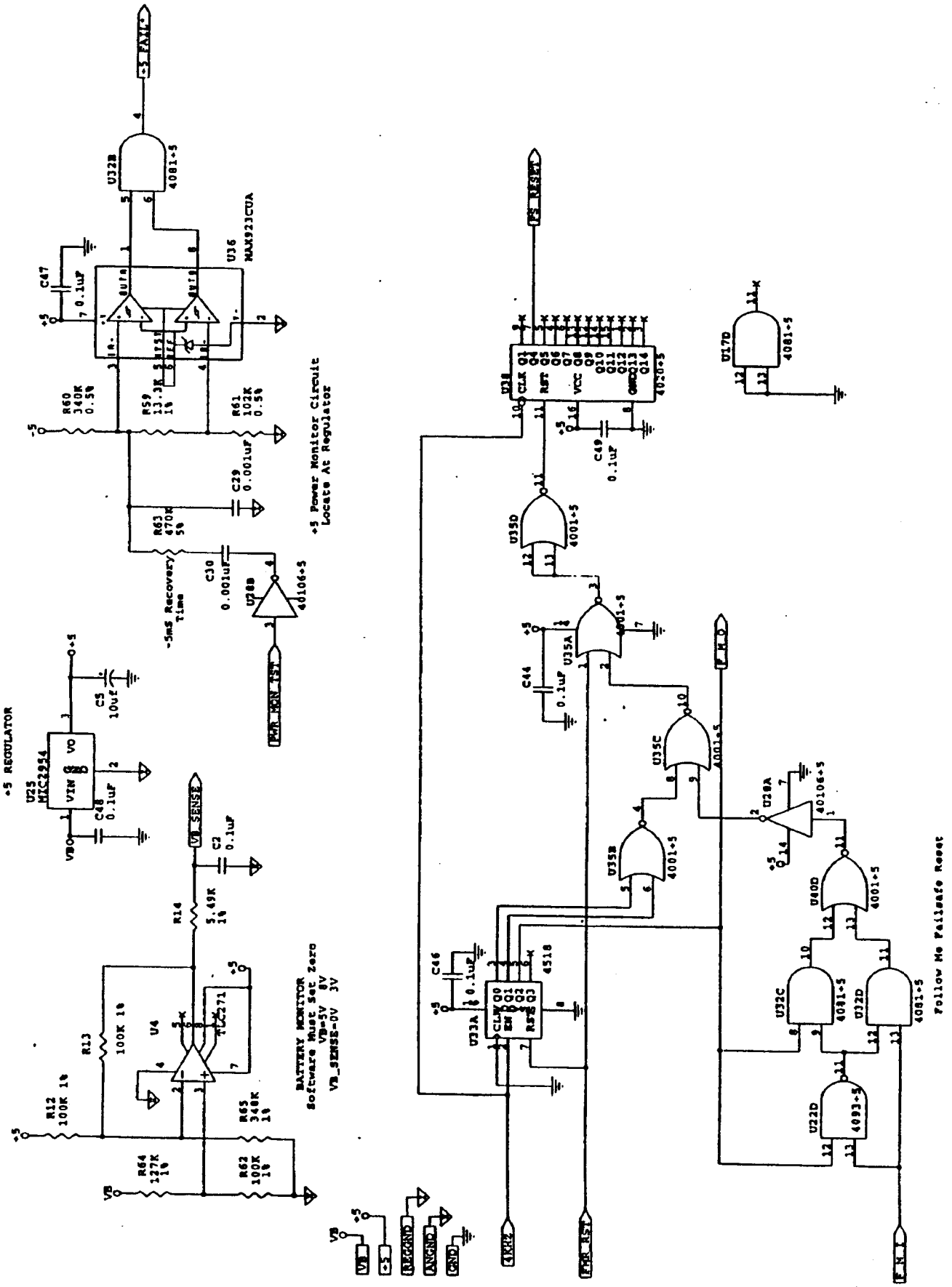
ANALOG PCB SCHEMATIC D-AS50-01-352 (1 of 4)



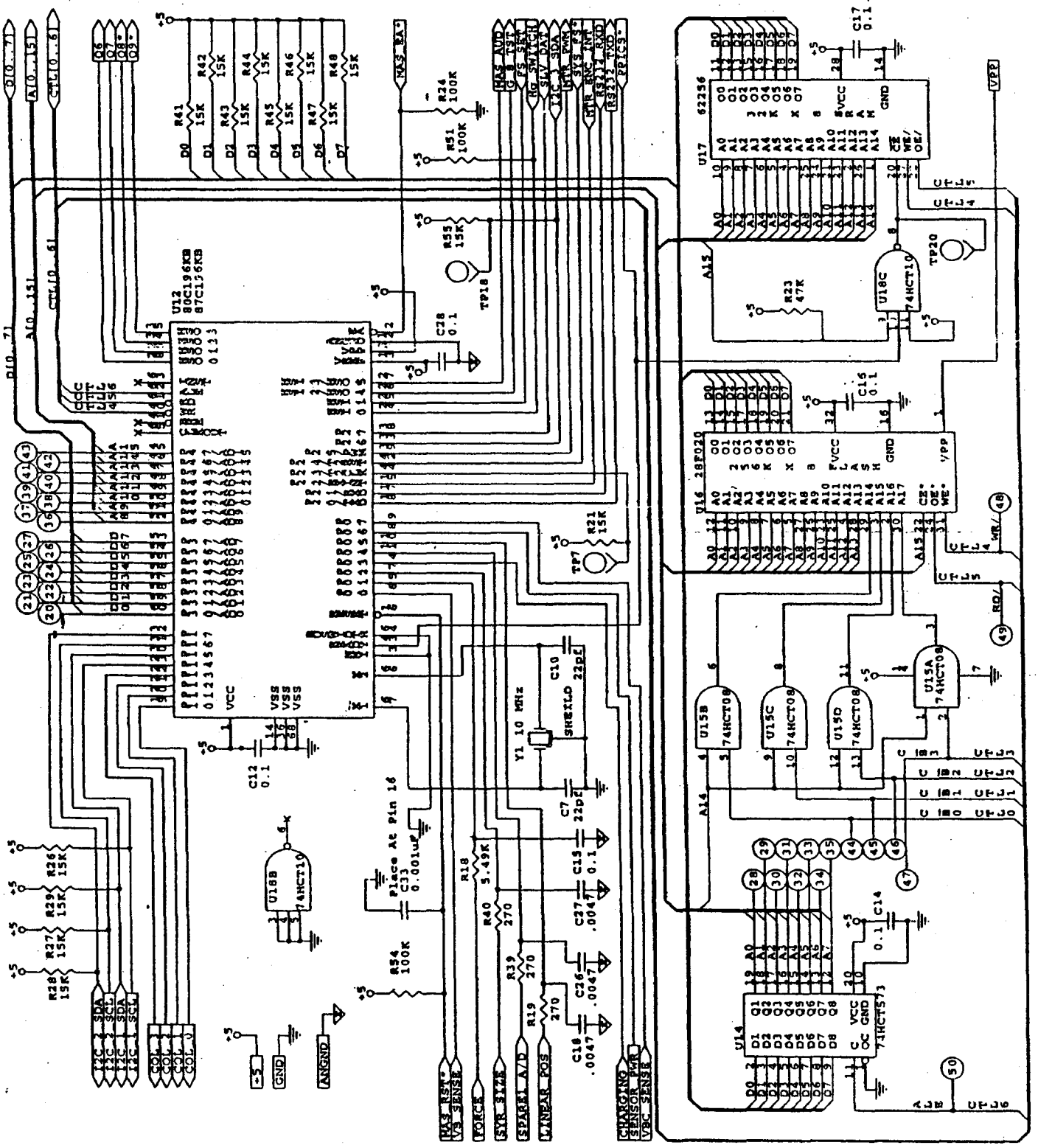
ANALOG PCB SCHEMATIC D-AS50-01-352 (2 of 4)



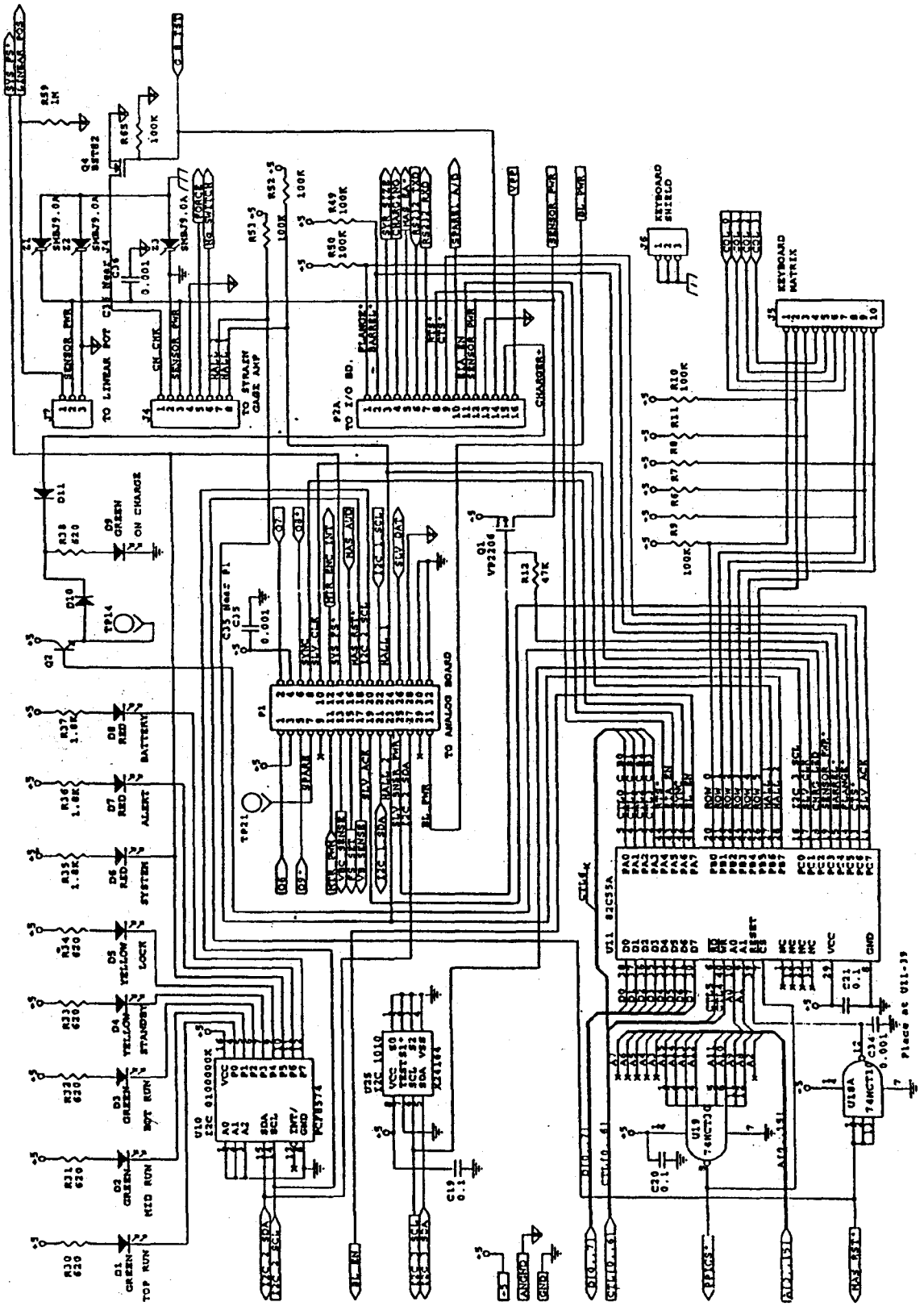
ANALOG PCB SCHEMATIC D-AS50-01-352 (3 of 4)



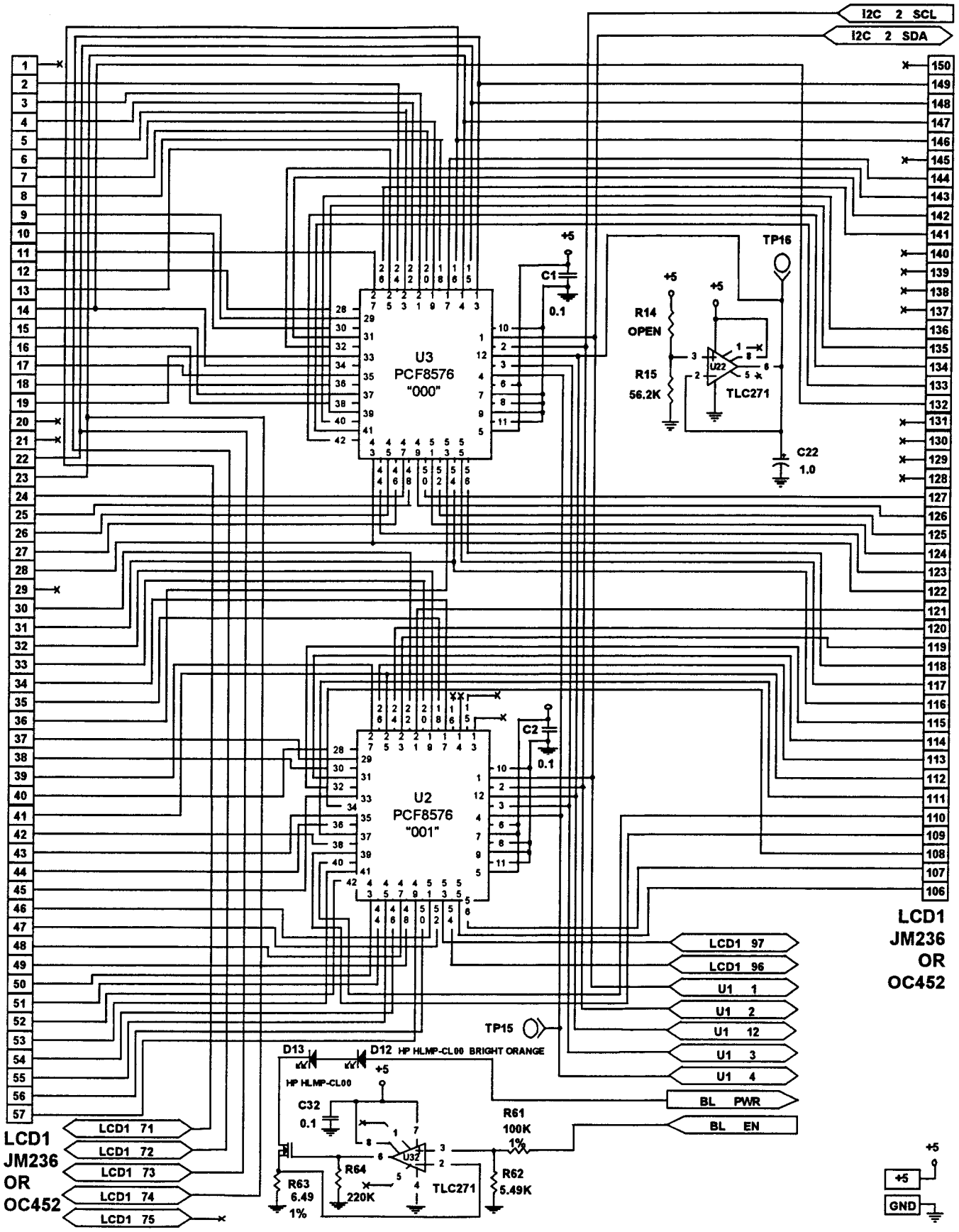
ANALOG PCB SCHEMATIC D-AS50-01-352 (4 of 4)



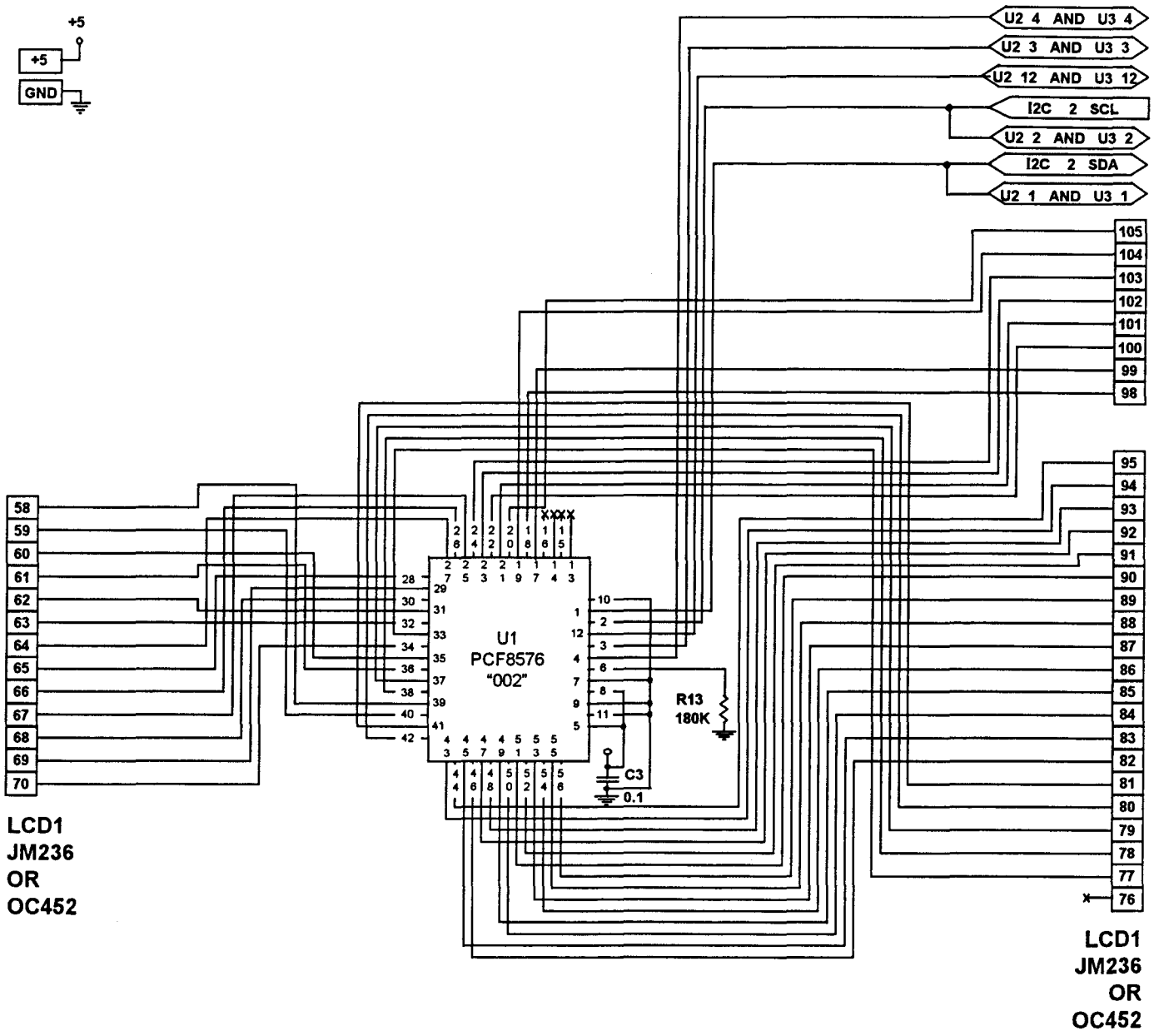
DIGITAL PCB SCHEMATIC D-AS50-01-353 (1 of 5)



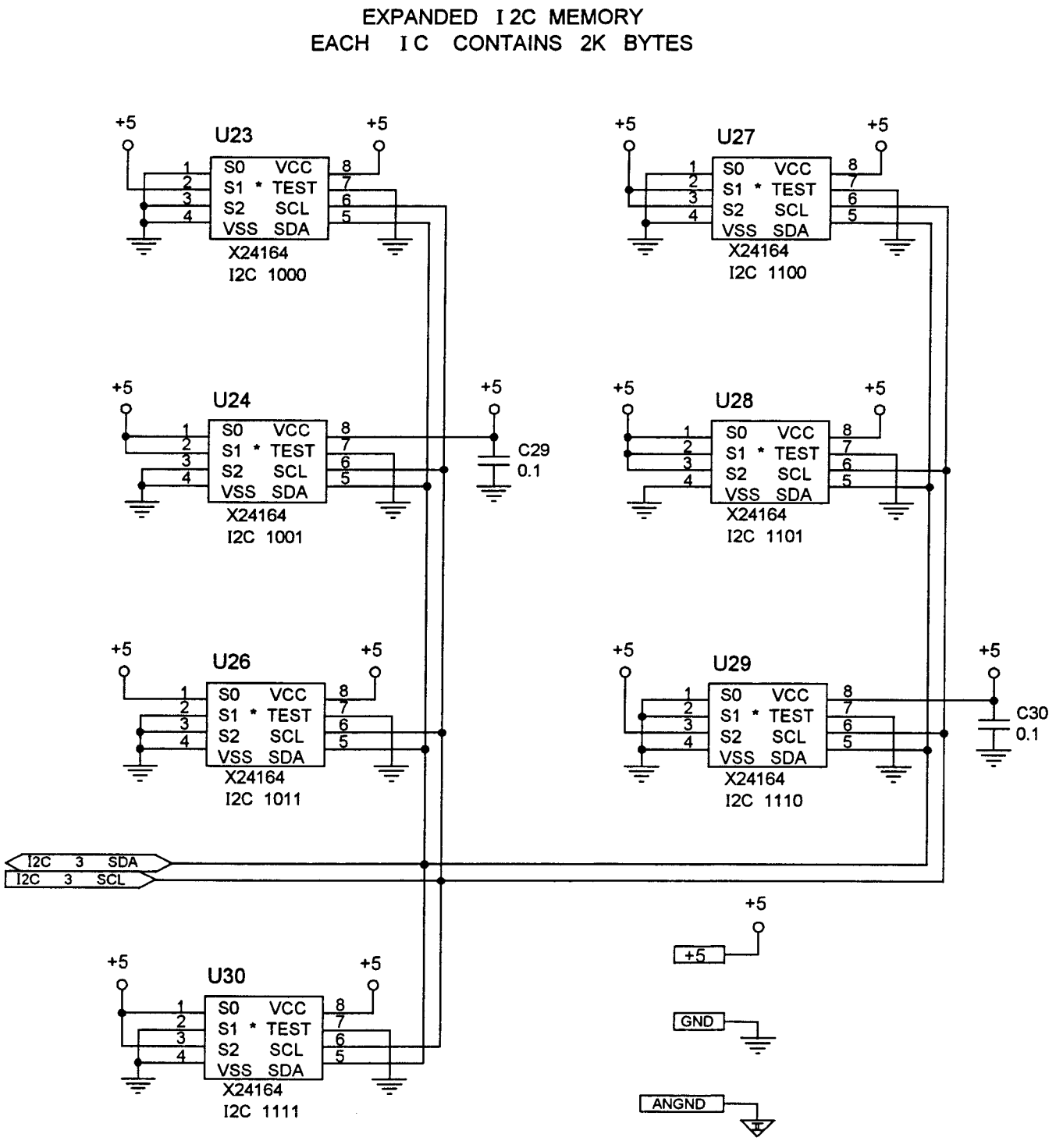
DIGITAL PCB SCHEMATIC D-AS50-01-353 (2 of 5)



DIGITAL PCB SCHEMATIC D-AS50-01-353 (3 of 5)



DIGITAL PCB SCHEMATIC D-AS50-01-353 (4 of 5)

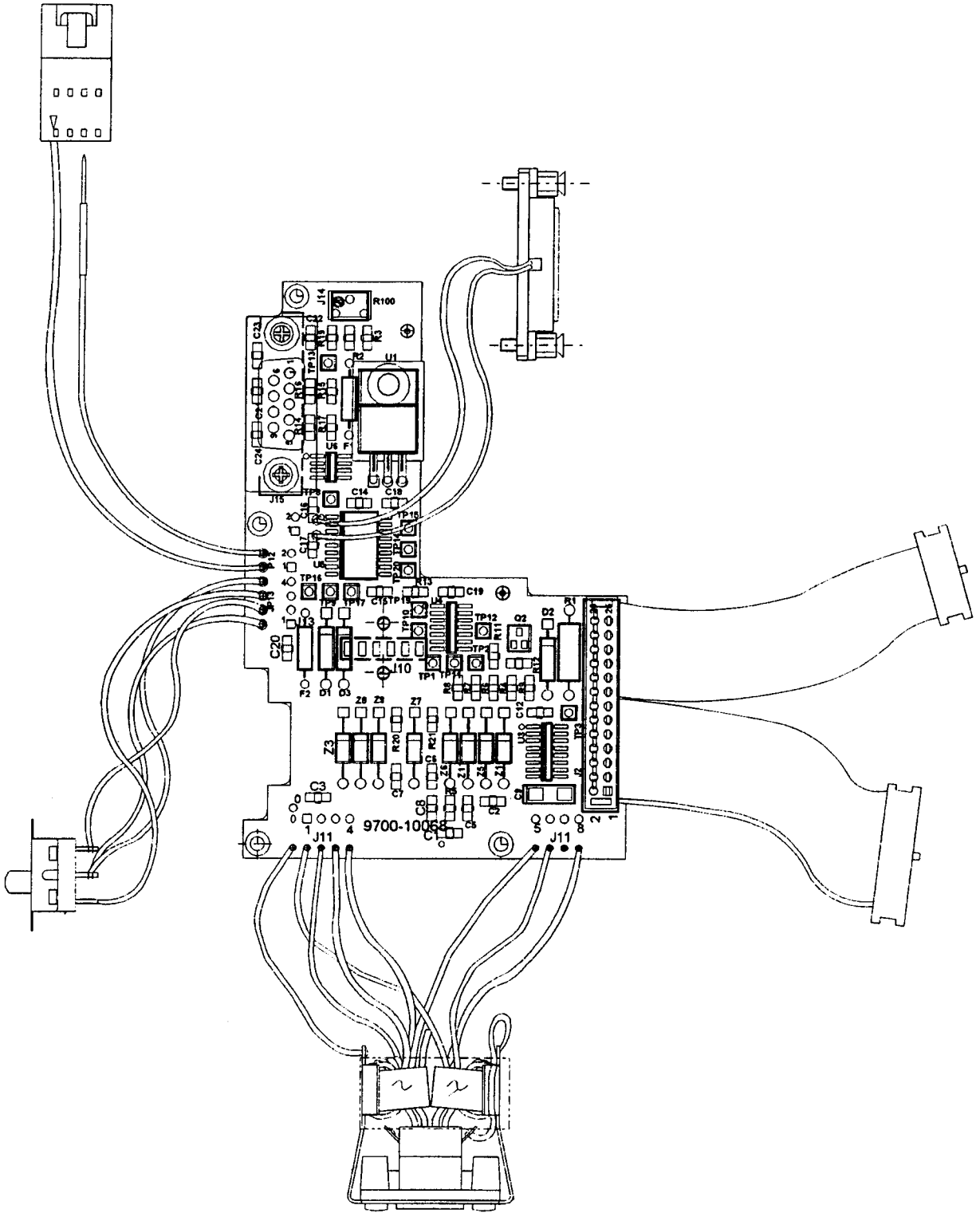


DIGITAL PCB SCHEMATIC D-AS50-01-353 (5 of 5)

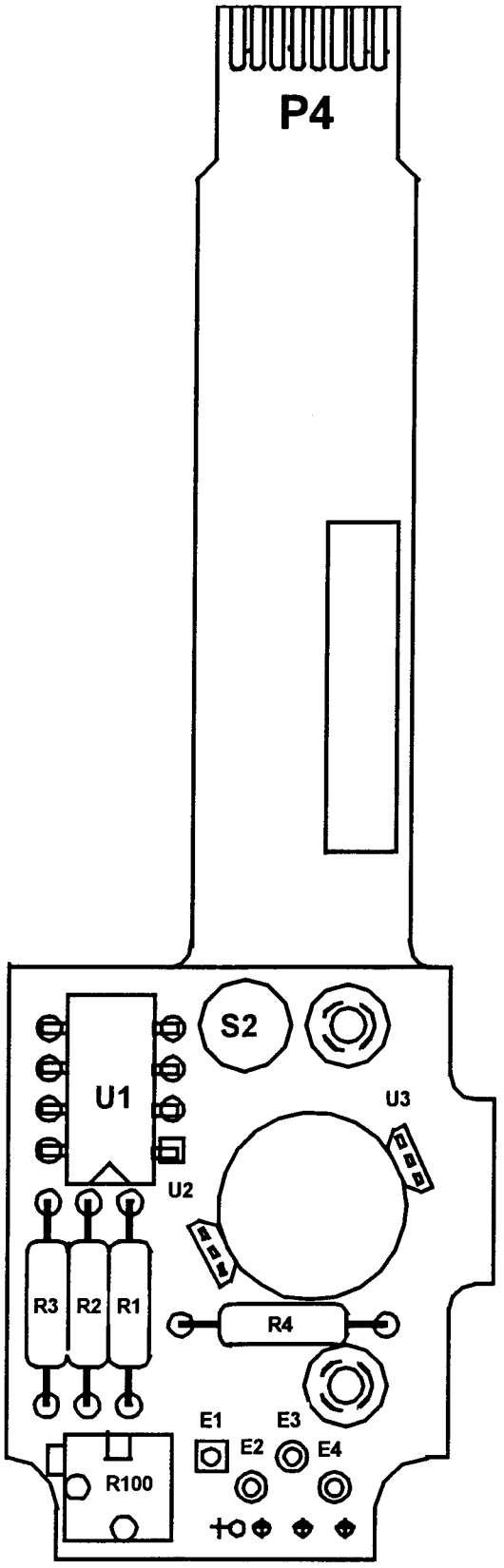
B.1 GENERAL

This appendix contains the circuit board assembly drawings for the pump. A table of contents for this section is shown below:

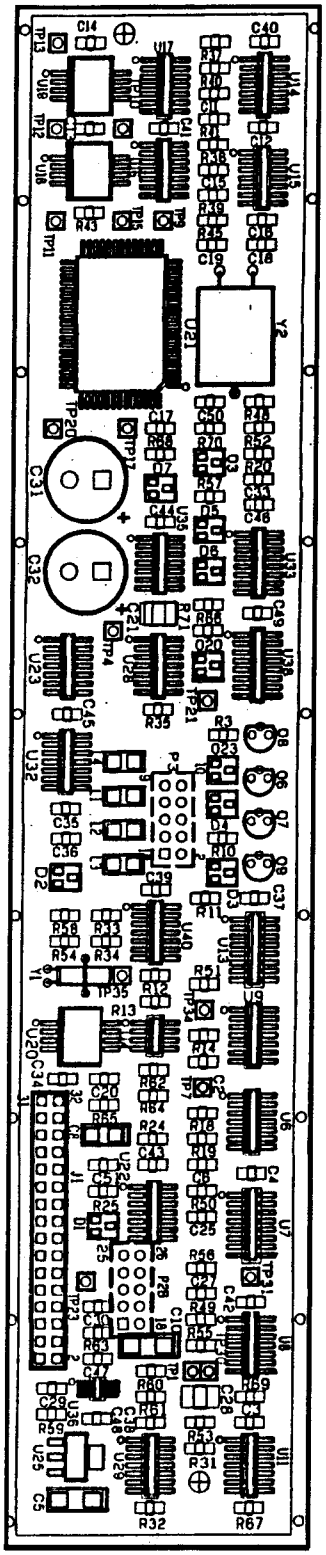
DRAWING NUMBER	DESCRIPTION
D-AS50-01-350	ASSEMBLY, AS50 PUMP, I/O BOARD
C-AS50-01-351	ASSEMBLY, AS50 PUMP, STRAIN GAUGE BOARD
D-AS50-01-352	ASSEMBLY, AS50 PUMP, ANALOG BOARD
D-AS50-01-353	ASSEMBLY, AS50 PUMP, DIGITAL BOARD



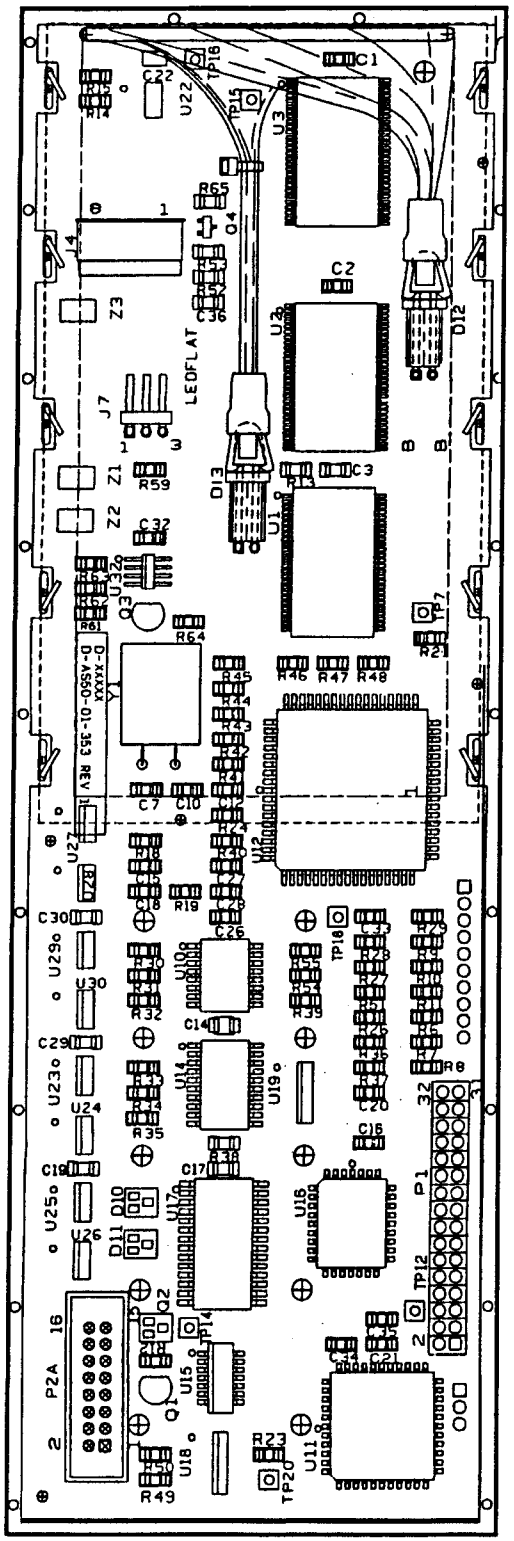
I/O PCB ASSEMBLY D-AS50-01-350



STRAIN GAUGE PCB ASSEMBLY C-AS50-01-351



ANALOG PCB ASSEMBLY D-AS50-01-352



DIGITAL PCB ASSEMBLY D-AS50-01-353

APPENDIX B CIRCUIT BOARD ASSEMBLY DRAWINGS

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C.1 GENERAL

This appendix contains a part listing of the components of the pump. There are three part list types contained in this appendix, by major assembly, alphabetical, and numerical. The numerical and alphabetical lists are cross referenced to the assembly specific parts list by figure and index number.

C.2 ASSEMBLY PART LISTINGS

This section contains a part listing by major assembly. A listing of the major assemblies is shown below:

- End Caps
- Pole Clamp
- Battery
- Barrel Clamp Assembly
- Cover Assembly
- Case Assembly
- Upper Plunger Assembly
- Charger

C.2.1 End Caps

Table C-A End Caps

Figure ID Number	Part Description	Baxter® Part Number	Quantity per Pump
A-1	End Caps, Black (Standard)	DAS4005481	2
	Gray	DAS4001481	2
	Blue	DAS4002481	2
	Green	DAS4003481	2
	Orange	DAS4004481	2
	Light Blue	DAS4006481	2
	Light Pink	DAS4007481	2
	Purple	DAS4008481	2

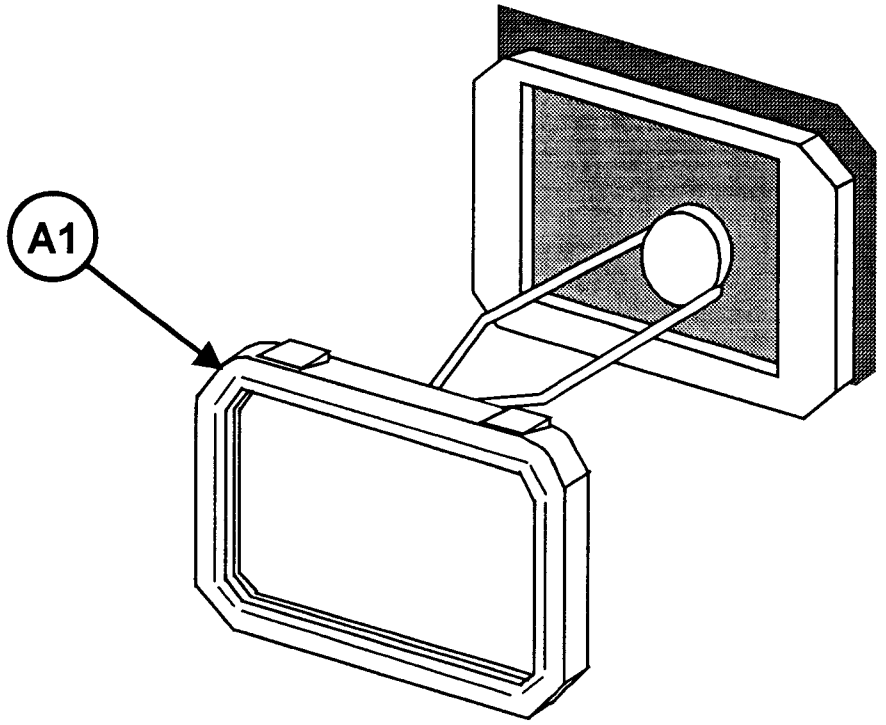

Figure C-A Bumpers

C.2.2 Pole Clamp Assembly

Table C-B Pole Clamp

Part Description	Baxter® Part Number	Quantity per Assembly
Pole Clamp Assembly	AAS5001500RP	1

The pump is provided with a removable IV pole clamp. The typical usage is for mounting the pump to a vertical pole. To adapt the pole clamp for use on a horizontal pole, first remove the pole clamp from the pump. Remove the screw on the back side of the pole clamp. Remove the jaw portion of the pole clamp, rotate 90 degrees and replace. Note that it is notched to fit the housing properly. Tighten the screw and reinstall the pole clamp.

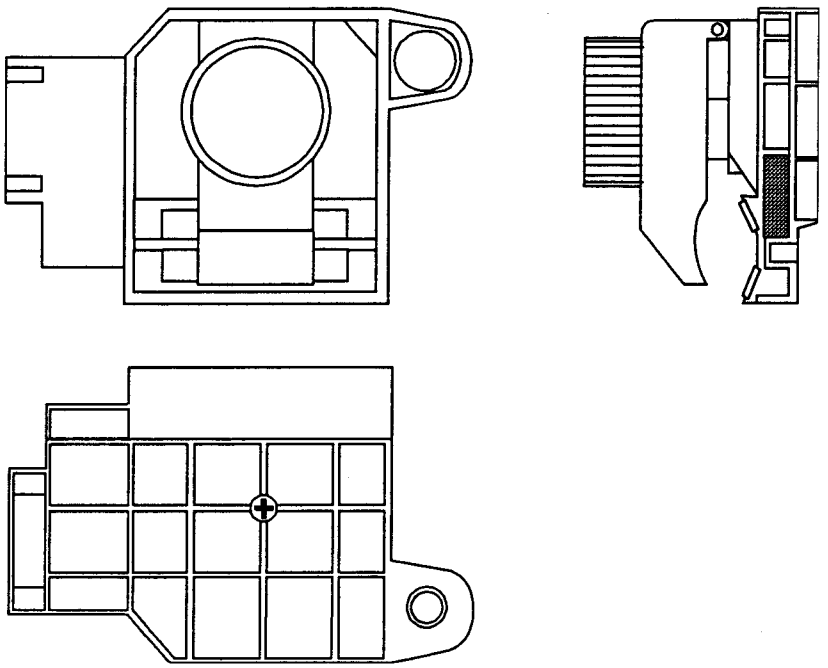

Figure C-B Pole Clamp

C.2.3 Battery Stack Assembly

Table C-C Battery

Figure ID Number	Part Description	Baxter® Part Number	Quantity per Assembly
C-1	Battery Stack Assembly	AAS4001552RP	1
C-2	Battery Cover Assembly	AAS5001473RP	1
C-3	2-32 x 3/16" Black Pan Head Philips Screws	S023203663	3

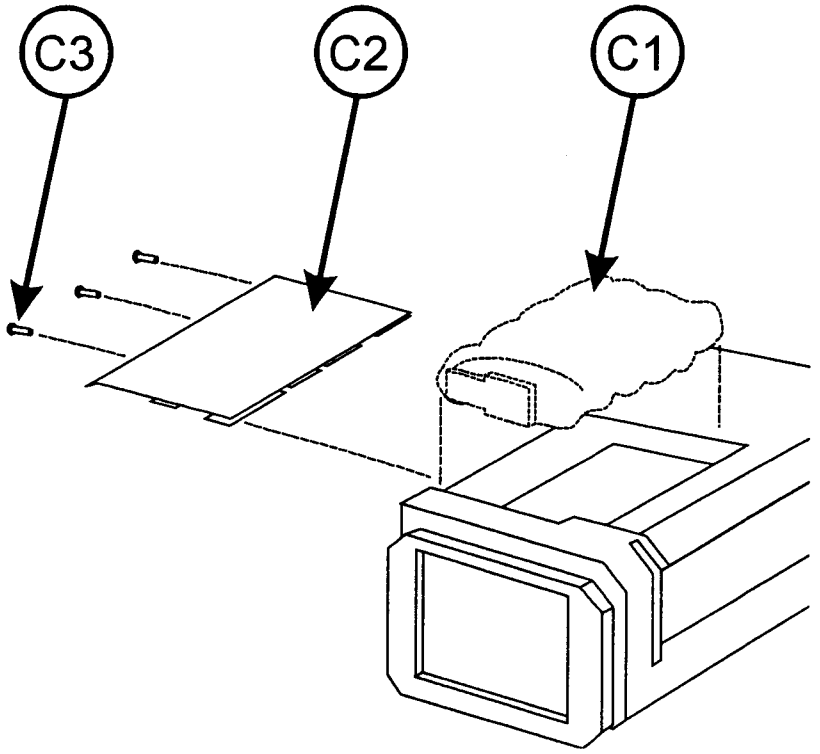

Figure C-C Battery

C.2.4 Barrel Clamp Assembly

Table C-D Barrel Clamp

Figure ID Number	Part Description	Baxter® Part Number	Quantity per Assembly
D-1	Barrel Clamp Assembly (Includes items D2-D10)	AAS5001503RP	1
D-2	AS50 Pump Caution Decal	BAS5001010	1
D-3	Clamp Face Decal	BAS5001009	1
D-4	Barrel Clamp Face	CAS5001453	1
D-5	Molded Lever End	CAS4001490	1
D-6	4-40 x 5/16" Flat Head Screw	S044005614	1
D-7	2-56 x 3/8" Socket Head Cap Screw	S025606600	2
D-8	2-56 x 11/16" Socket Head Cap Screw	S025611600	1
D-9	Barrel Clamp Zebra Strip	A100301249	1
D-10	4-40 Hex Nut	N044002665	1
D-11	4-40 x 1/2" Flat Head Screw	S044008614	3

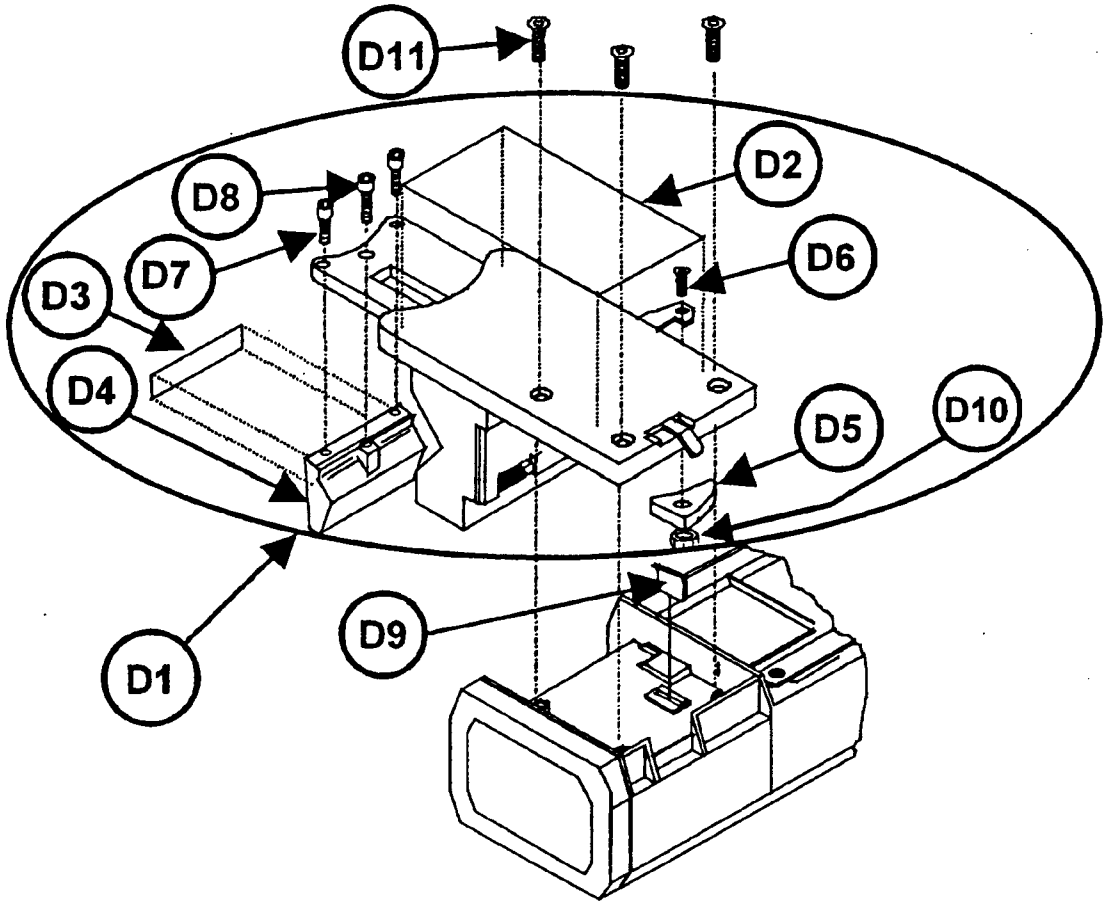

Figure C-D Barrel Clamp Assembly

C.2.5 Cover Assembly

Table C-E Cover Assembly

Figure ID Number	Part Description	Baxter® Part Number	Quantity per Assembly
E-1	Cover/Window Assembly	AAS5001522RP	1
E-2	2-56 x 9/16" Socket Head Cap Screw	S025609600	4
E-3	Plunger Warning Decal	BAS5001018	1
E-4	Cover Screw	BAS4001653	1
E-5	Digital/LCD PCB Assembly	DAS5001353	1
E-6	Electronic Chassis	DAS4001410	1
E-7	Analog PCB Retainer	DAS4001409	1
E-8	Analog PCB Assembly	DAS5001352	1
E-9	Keypad Assembly	AAS5001523RP	1
E-10	Conductive Gasket (cut gasket material into 8 pieces as listed below:)	BAS4001486	1
	Quantity: 2 — Length: 8 3/4" — Used with PCB Assy: Digital/LCD		
	Quantity: 2 — Length: 2 11/16" — Used with PCB Assy: Digital/LCD		
	Quantity: 2 — Length: 8 3/4" — Used with PCB Assy: Analog		
	Quantity: 2 — Length: 1 5/8" — Used with PCB Assy: Analog		
E-11	Digital PCB Retainer	DAS4001408	1
E-12	Charger Port Decal	BAS5001013	1

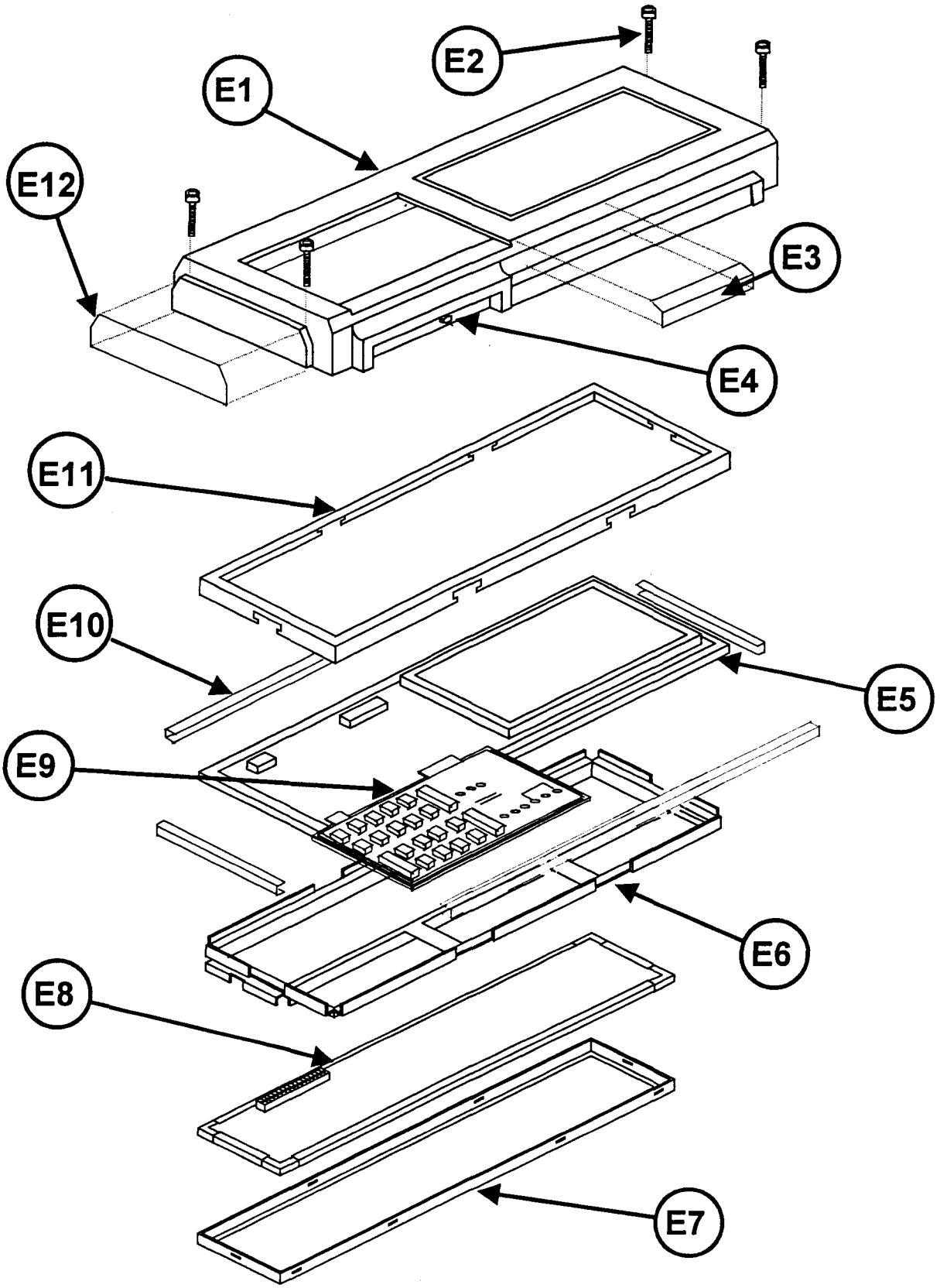

Figure C-E Cover Assembly

C.2.6 Case Assembly

Table C-F Case Assembly

Figure ID Number	Part Description	Baxter® Part Number	Quantity per Assembly
F-1	Case/IV Pole Loop/Drive Assembly	AAS5001531RP	1
F-2	Battery Warning Decal	BAS5001011	1
F-3	10-32 x 3/8" Hex Insert	A100301439	1
F-4	RS232 Connector Cover	BAS5001475	1
F-5	4-40 x 3/16" Button Head Screw	S044003613	2
F-6	Product Code Label	BAS5001016	1
F-7	Switch Bezel With Markings	BAS5001603	1
F-8	Instruction Decal	BAS5001015	1
F-9	RS232 Gasket	BAS5001425	1
F-10	Connector Spacer	BAS4001622	1
F-11	I/O Board Assembly	DAS5001350	1
F-12	Switch Gasket	BAS4001015	1
F-13	Switch Retainer Spring	BAS4001602	1
F-14	2-56 x 1/8" Socket Head Cap Screw	S025602600	2
F-15	2-56 x 1/4" Pan Head Screw	S025604652	8
F-16	.036" Stainless Steel Washer	A100301429	1
F-17	10-32 x 1/4" Pan Head Screw	S103204613	1
F-18	Overlay Decal	BAS4000046	1

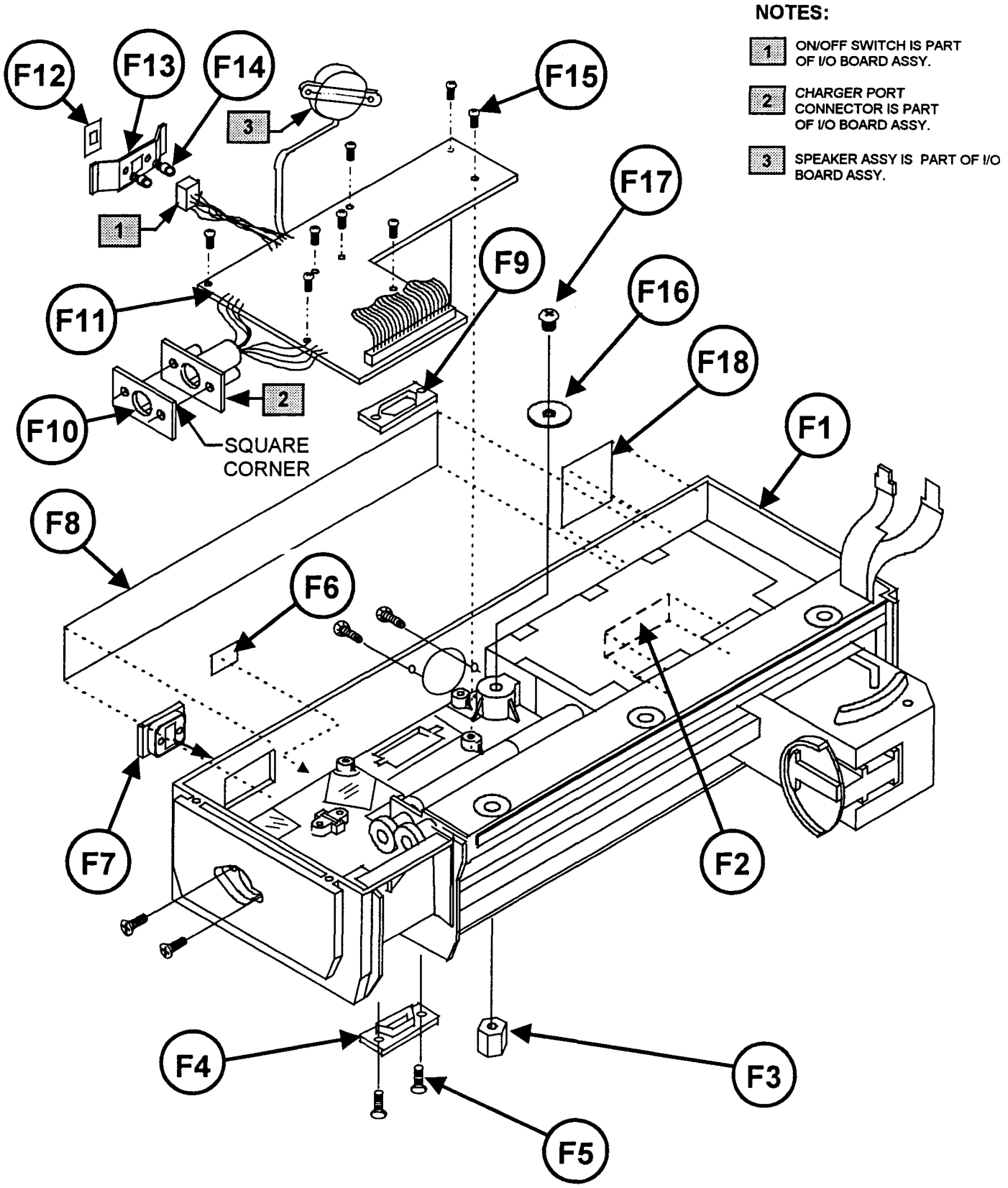

Figure C-F Case Assembly

C.2.7 Upper Plunger Assembly

Table C-G Upper Plunger Assembly

Figure ID Number	Part Description	Baxter® Part Number	Quantity per Assembly
G1	Upper Plunger Assembly (Includes items G2 and G3)	AAS5001506RP	1
G2	Plunger Driver Slide	DAS5001455	1
G3	Stepped Pin	BAS5001406	1
G4	Plunger Driver Decal	BAS5001017	1
G5	Lever Pin	BAS5001408	1

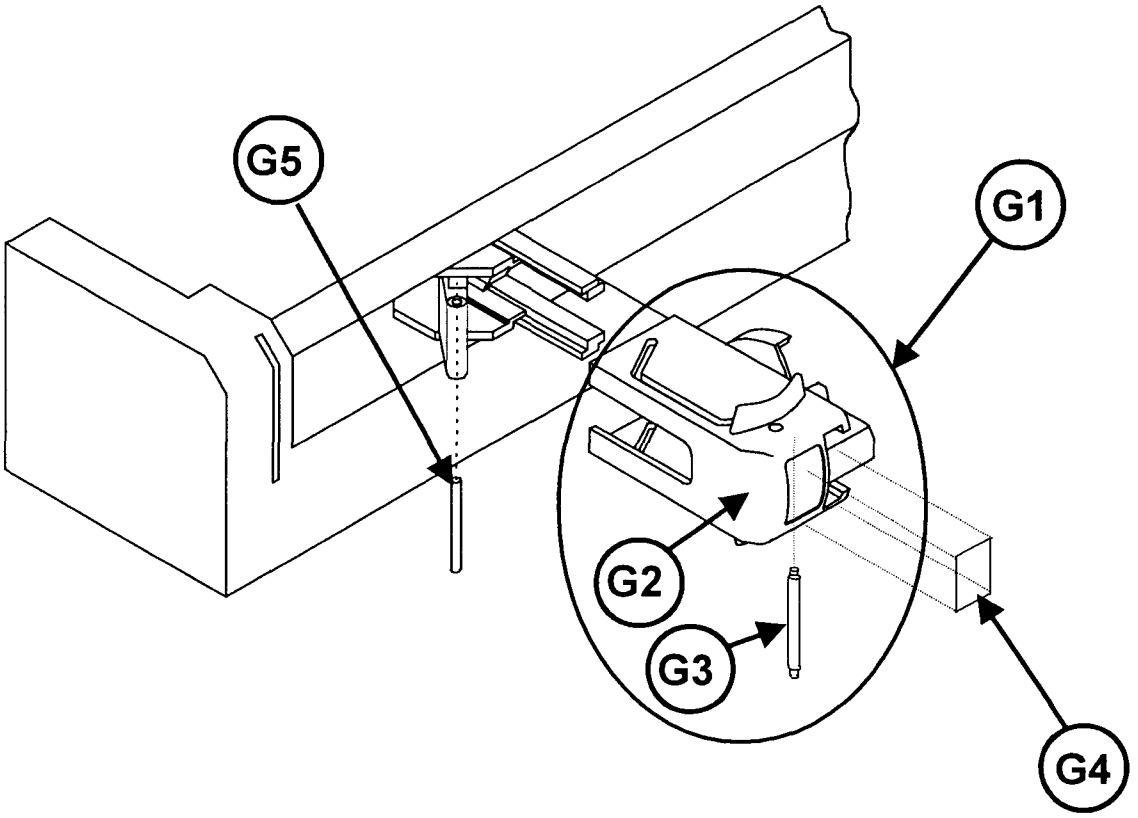

Figure C-G Upper Plunger Assembly

C.2.8 Charger Assembly

Table C-H Charger Assembly

Part Description	Baxter® Part Number	Quantity per Assembly
Charger Assembly	CAS4001900	1

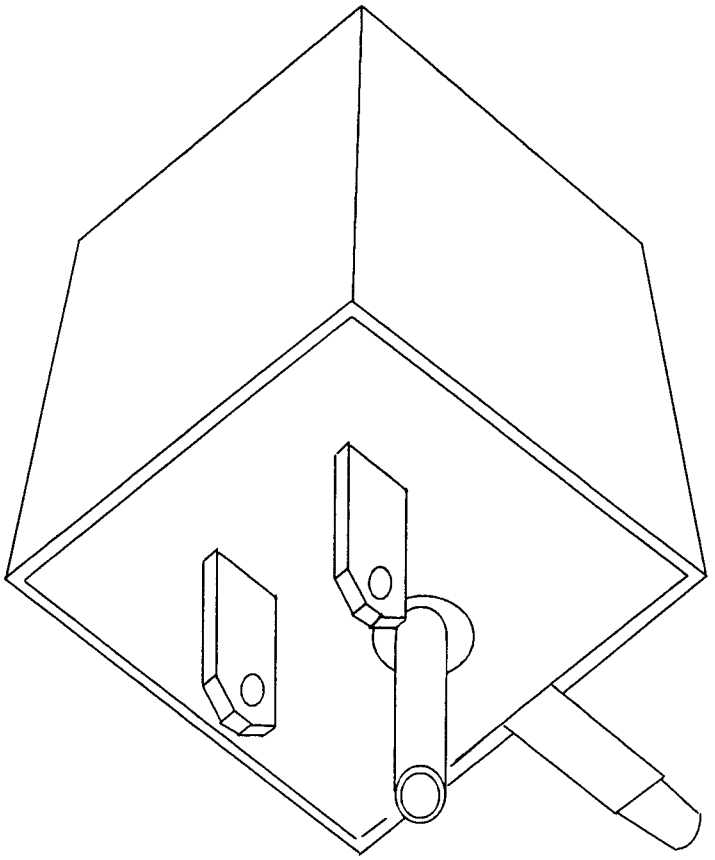

Figure C-H Charger

C.3 ALPHABETICAL PARTS LIST

Description	Baxter® Part Number	Figure Number	Index Number	Unit Qty
.036 Stainless Steel Washer	A100301429	F	F-16	1
10-32 x 1/4" Pan Head Screw	S103204613	F	F-17	1
10-32 x 3/8" Hex Insert	A100301439	F	F-3	1
2-32 x 3/16" Black Pan Head Screw	S023203663	C	C-3	3
2-56 x 1/4" Pan Head Screw	S025604652	F	F-15	8
2-56 x 1/8" Socket Head Cap Screw	S025602600	F	F-14	2
2-56 x 11/16" Socket Head Cap Screw	S025611600	D	D-8	1
2-56 x 3/8" Socket Head Cap Screw	S025606600	D	D-7	2
2-56 x 9/16" Socket Head Cap Screw	S025609600	E	E-2	4
4-40 x 1/2" Flat Head Screw	S044008614	D	D-11	3
4-40 x 5/16" Flat Head Screw	S044005614	D	D-6	1
4-40 x 3/16" Button Head Screw	S044003613	F	F-5	2
4-40 Hex Nut	N044002665	D	D-10	1
Analog PCB Assembly	DAS5001352	E	E-8	1
Analog PCB Retainer	DAS4001409	E	E-7	1
AS50 Pump Caution Decal	BAS5001010	D	D-2	1
Barrel Clamp Assembly	AAS5001503RP	D	D-1	1
Barrel Clamp Face	CAS5001453	D	D-4	1
Barrel Clamp Zebra Strip	A100301249	D	D-9	1
Battery Cover Assembly	AAS5001473RP	C	C-2	1
Battery Stack Assembly	AAS4001552RP	C	C-1	1
Battery Warning Decal	BAS5001011	F	F-2	1
Case/IV Pole Loop/Drive Assembly	AAS5001531RP	F	F-1	1
Charger Assembly	CAS4001900	H	NA	1
Charger Port Decal	BAS5001013	E	E-12	1
Clamp Face Decal	BAS5001009	D	D-3	1
Conductive Gasket	BAS4001486	E	E-10	1
Connector Spacer	BAS4001622	F	F-10	1
Cover Screw	BAS4001653	E	E-4	1
Cover/Window Assembly	AAS5001522RP	E	E-1	1
Digital PCB Retainer	DAS4001408	E	E-11	1
Digital/LCD PCB Assembly	DAS5001353	E	E-5	1
Electronic Chassis	DAS4001410	E	E-6	1
End Cap, Black Rubber	DAS4005481	A	A-1	2
End Cap, Blue Rubber	DAS4002481	A	A-1	2
End Cap, Gray Rubber	DAS4001481	A	A-1	2
End Cap, Green Rubber	DAS4003481	A	A-1	2
End Cap, Light Blue Rubber	DAS4006481	A	A-1	2
End Cap, Light Pink Rubber	DAS4007481	A	A-1	2

C.3 ALPHABETICAL PARTS LIST (CONTINUED)

Description	Baxter® Part Number	Figure Number	Index Number	Unit Qty
End Cap, Orange Rubber	DAS4004481	A	A-1	2
End Cap, Purple Rubber	DAS4008481	A	A-1	2
I/O PCB Assembly	DAS5001350	F	F-11	1
Instruction Decal	BAS5001015	F	F-8	1
Keypad Assembly	AAS5001523RP	E	E-9	1
Lever Pin	BAS5001408	G	G-5	1
Molded Lever End	CAS4001490	D	D-5	1
Overlay Decal	BAS4000046	F	F-18	1
Plunger Driver Decal	BAS5001017	G	G-4	1
Plunger Driver Slide	DAS5001455	G	G-2	1
Plunger Warning Decal	BAS5001018	E	E-3	1
Pole Clamp Assembly	AAS5001500RP	B	NA	1
Product Code Label	BAS5001016	F	F-6	1
RS232 Connector Cover	BAS5001475	F	F-4	1
RS232 Gasket	BAS5001425	F	F-9	1
Stepped Pin	BAS5001406	G	G-3	1
Switch Bezel with markings	BAS5001603	F	F-7	1
Switch Gasket	BAS4001015	F	F-12	
Switch Retainer Spring	BAS4001602	F	F-13	
Upper Plunger Assembly	AAS5001506RP	G	G-1	

C.4 NUMERICAL PARTS LIST

Baxter® Part Number	Description	Figure Number	Index Number	Unit Qty
A100301249	Barrel Clamp Zebra Strip	D	D-9	1
A100301429	.036 Stainless Steel Washer	F	F-16	1
A100301439	10-32 x 3/8" Hex Insert	F	F-3	1
AAS4001552RP	Battery Stack Assembly	C	C-1	1
AAS5001473RP	Battery Cover Assembly	C	C-2	1
AAS5001500RP	Pole Clamp Assembly	B	NA	1
AAS5001503RP	Barrel Clamp Assembly	D	D-1	1
AAS5001506RP	Upper Plunger Assembly	G	G-1	1
AAS5001522RP	Cover/Window Assembly	E	E-1	1
AAS5001523RP	Keypad Assembly	E	E-9	1
AAS5001531RP	Case/IV Pole Loop/Drive Assembly	F	F-1	1
BAS4000046	Overlay Decal	F	F-18	1
BAS4001015	Switch Gasket	F	F-12	1
BAS4001486	Conductive Gasket	E	E-10	1
BAS4001602	Switch Retainer Spring	F	F-13	1
BAS4001622	Connector Spacer	F	F-10	1
BAS4001653	Cover Screw	E	E-4	1
BAS5001009	Clamp Face Decal	D	D-3	1
BAS5001010	AS50 Pump Caution Decal	D	D-2	1
BAS5001011	Battery Warning Decal	F	F-2	1
BAS5001013	Charger Port Decal	E	E-12	1
BAS5001015	Instruction Decal	F	F-8	1
BAS5001016	Product Code Label	F	F-6	1
BAS5001017	Plunger Driver Decal	G	G-4	1
BAS5001018	Plunger Warning Decal	E	E-3	1
BAS5001406	Stepped Pin	G	G-3	1
BAS5001408	Lever Pin	G	G-5	1
BAS5001425	RS232 Gasket	F	F-9	1
BAS5001475	RS232 Connector Cover	F	F-4	1
BAS5001603	Switch Bezel with markings	F	F-7	1
CAS4001490	Molded Lever End	D	D-5	1
CAS4001900	Charger Assembly	H	NA	1
CAS5001453	Barrel Clamp Face	D	D-4	1
DAS4001408	Digital PCB Retainer	E	E-11	1
DAS4001409	Analog PCB Retainer	E	E-7	1
DAS4001410	Electronic Chassis	E	E-6	1
DAS4001481	End Cap, Gray Rubber	A	A-1	2

C.4 NUMERICAL PARTS LIST (CONTINUED)

Baxter® Part Number	Description	Figure Number	Index Number	Unit Qty
DAS4002481	End Cap, Blue Rubber	A	A-1	2
DAS4003481	End Cap, Green Rubber	A	A-1	2
DAS4004481	End Cap, Orange Rubber	A	A-1	2
DAS4005481	End Cap, Black Rubber	A	A-1	2
DAS4006481	End Cap, Light Blue Rubber	A	A-1	2
DAS4007481	End Cap, Light Pink Rubber	A	A-1	2
DAS4008481	End Cap, Purple Rubber	A	A-1	2
DAS5001350	I/O PCB Assembly	F	F-11	1
DAS5001352	Analog PCB Assembly	E	E-8	1
DAS5001353	Digital/LCD PCB Assembly	E	E-5	1
DAS5001455	Plunger Driver Slide	G	G-2	1
N044002665	4-40 Hex Nut	D	D-10	1
S023203663	2-32 x 3/16" Black Pan Head Screw	C	C-3	3
S025602600	2-56 x 1/8" Socket Head Cap Screw	F	F-14	2
S025604652	2-56 x 1/4" Pan Head Screw	F	F-15	8
S025606600	2-56 x 3/8" Socket Head Cap Screw	D	D-7	2
S025609600	2-56 x 9/16" Socket Head Cap Screw	E	E-2	4
S025611600	2-56 x 11/16" Socket Head Cap Screw	D	D-8	1
S044003613	4-40 x 3/16" Button Head Screw	F	F-5	2
S044005614	4-40 x 5/16" Flat Head Screw	D	D-6	1
S044008614	4-40 x 1/2" Flat Head Screw	D	D-11	3
S103204613	10-32 x 1/4" Pan Head Screw	F	F-17	1

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D.1 GENERAL

This appendix describes major updates to the pump. The updates are listed by serial number and/or software revision number of when the change occurred. In many instances a different part number is assigned for compatibility reasons. To ensure proper fit and operation of parts, make sure that you check all updates that may apply to a particular serial number.

CHANGES TO SERVICE MANUAL ARTWORK REV. A INCLUDE THE FOLLOWING:

1. Change in software version from V7.00.04 to V7.01.05. This includes changes to the Master Processor error codes listed in section 6.4. It also allows the date and time to be replicated from a source pump.

2. The Factory Default Configuration changed as follows (refer to section 8.6):

   2.1 The "LIBRARY" option in the MISC Group changed from Y to N.

   2.2 The "ENABLE DB9 PORT" option in the MISC Group changed from N to Y.

   2.3 The IDENT Group identifier changed from "THANKYOU" to "AS50."

3. The acceptable occlusion range changed from 13.5 – 17.5 psi to 12.0 – 20.0 psi (refer to section 4.2).

4. The Molded End Lever design was modified (refer to sections 7.2 and C.2). The original lever was mounted with a 4-40 x 1/4" flat head screw. The revised lever is mounted with a 4-40 x 5/16" flat head screw and a hex nut.

5. The recommended battery charge time was changed from 24 hrs. to 16 hrs. (refer to sections 4.1 and 6.2).

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Revision	Date	General Description of Changes
0	3/98	Release
A	1/99	Software version and default configuration changes.

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INTRODUCTION	THEORY OF OPERATION	INITIAL INSPECTION AND DAMAGE CHECK	FUNCTIONAL TESTS	ROUTINE MAINTENANCE	TROUBLESHOOTING AND REPAIR	DISASSEMBLY/ ASSEMBLY PROCEDURES
DISASSEMBLY/ ASSEMBLY PROCEDURES	TROUBLESHOOTING AND REPAIR	ROUTINE MAINTENANCE	FUNCTIONAL TESTS	INITIAL INSPECTION AND DAMAGE CHECK	THEORY OF OPERATION	INTRODUCTION
SYSTEM CONFIGURATION	CONFIGURATION REPLICATION	ALERTS AND ALARMS	SCHEMATICS AND WIRING DIAGRAMS	CIRCUIT BOARD ASSEMBLY DRAWINGS	REPAIR PARTS	PRODUCT UPDATES
PRODUCT UPDATES	REPAIR PARTS	CIRCUIT BOARD ASSEMBLY DRAWINGS	SCHEMATICS AND WIRING DIAGRAMS	ALERTS AND ALARMS	CONFIGURATION REPLICATION	SYSTEM CONFIGURATION
MANUAL REVISION NOTICES	REPAIR HISTORY					
					REPAIR HISTORY	MANUAL REVISION NOTICES